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SURGICAL PHYSIOLOGY.[1]

By George W. Crile, M. D.,

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In the earliest period of its development surgery was wholly empiric. The period of gross anatomy which followed gave rise to a splendid development of the mechanics of surgery, a development that long ago reached its zenith. Gross anatomy led to the unfolding of minute anatomy and pathologic anatomy. Upon this foundation was erected the splendid structure of surgical pathology and bacteriology. Previous to this time surgery, like law, was taught and practiced largely by precedents. Surgical pathology and bacteriology transformed the old anatomic surgery. The approximate causes of the majority of the surgical diseases are now known, or correlated, but what can we say as to the development of our knowledge of the vital processes of surgical importance? We know the gross and the minute appearance after death. What knowledge have we of the physiologic alterations leading up to death or to recovery, or of the wonderful scope and method of compensation in injury and in disease, or of the local and of the general resistance toward infection?

[1] Read before the Johns Hopkins Hospital Medical Society, March 20, 1905.

Anatomy, pathology, and bacteriology contribute a scientific basis, a house from which an inference as to the life history of its previous inhabitants may be drawn.

Surgical practice rests largely upon altered physiologic actions, or upon surgical physiology. As illustrations let us consider a few of the simplest phases of the surgical physiology of operative surgery as relates to two of the most vital phenomena—respiration and circulation.

With the definite knowledge that in respiratory obstruction respirations are not immediately arrested, but are stimulated in force, though not in frequency, and that in mechanical stimulation of the laryngeal mucosa there is usually an immediate respiratory arrest, there should not be a moment of doubt in differentiating between reflex inhibition and obstruction, thereby avoiding certain crises in the extraction of foreign bodies or in performing intubations. When there is threatened asphyxia from the pressure of tumors, requiring the aid of the accessory muscles of respiration, with the knowledge that these muscles are voluntary and are paralyzed by general anesthesia, the too frequent catastrophe of sudden death from paralysis of these muscles could not occur. In administering

anesthetics, were students in the physiologic laboratory made familiar with the respiratory arrest caused by pulling the tongue forward too forcibly and swabbing the region of the epiglottis, the vicious circle of greater effort, causing more inhibition, and the increased inhibition inducing the anesthetizer to greater stimulation of the inhibitory area of the throat, would cease to be an incident in the earlier experience of the hospital interne. The markedly increased respiratory action caused by the manipulation of certain areas, as divulsion of the anus, deep manipulation in the pelvis involving the sigmoid and the rectum, extensive manipulation of the peritoneum, causing a temporary increase in the exchange of air and equally of the anesthetic, especially in the case of chloroform, has produced dangerous collapse and even death.

Manipulations of the peritoneum, if rough and considerable, especially in the neighborhood of the diaphragm, as so often noted in stomach and gall-bladder surgery, produce a reflex excitation of the abdominal expiratory muscles, and often cause an expulsion of the intestines through the incision. Appreciation of this purely reflex physiologic phenomenon would prevent the anesthetizer from trying to anesthetize it away, under the impression that the patient was coming out from the anesthetic, neither would the surgeon institute the vicious circle of increasing the reflex expulsive force by roughly manipulating the intestines in trying to force them back, causing an equal increase in the expulsive contractions.

In peritonitis the surgeon would note that the abdominal factor of respiration is eliminated and that the superior costal type of respiration is substituted, and that since only the upper parts of the lungs are being used, the respiratory exchange must be the more rapid to compensate for its shallowness, that the scaleni and the levatores on palpation show greatly increased action, that the upper chest excursions are greatly increased in amplitude, and that the lower chest is even and flat. These phenomena are but physiologic inhibitions and compensations, and are of high diagnostic value.

The surgical physiology of the circulation is more vital than that of the respiration. The control of the circulation often means the control of life itself and constitutes the most important factor in the immediate operative results.

Physiology has shown that quite independent of general anesthesia the manipulation of any sensitive tissue sends impulses to the vasomotor center, modifying it in a physiologic sense, and that if these impulses are strong enough or numerous enough, this center becomes functionally impaired, and that this impairment may be sufficient to render the center wholly inactive. *Pari passu* with the development of this functional impairment the blood-pressure falls. The lower blood-pressure then becomes a factor in the further impairment of the vasomotor center by diminishing its nutrition. When the center has reached a state of complete functional dissolution it cannot be restored by its own action, since it is no longer excitable.

A knowledge of the definite physiologic laws governing this state would always guard the surgeon against excessive manipulation, would spare the patient the extra stress of therapeutic stimulation, and would lead the surgeon to support the circulation by mechanical means, such as saline infusions, posture, bandaging, or better still the rubber pneumatic suit. It would also lead him to secure the rest required for restoration.

The respiratory and the vasomotor centers are especially dependent upon a certain blood-pressure for their functionation. Note some of the powerful compensating mediums for maintaining the required blood-pressure. When there is an increased intracranial pressure from abscesses, hemorrhage, tumors, etc., a marked resistance to the intracranial circulation arises, threatening the nutrition of these centers. At once the vaso-constrictor impulses are sent out, especially to the splanchnic area. The blood-pressure rises to overcome this, hence the hard pulse and the high blood-pressure so characteristic of increased intracranial pressure.

How many times has this pathologic pulse misled the unphysiologic surgeon to a false security? How often has such a patient, whose compensating mechanism has been taxed to its utmost, been given full anesthesia, especially chloroform, causing just a sufficient fall in the blood-pressure to produce a sudden arrest of respiration and soon after of the circulation as well?

The simplest proposition in physiology is the slowing of the pulse and the rise in the blood-pressure in asphyxia. The pulse is increasingly slowed until the moment of death in asphyxia, yet how often have surgeons made a fatal misinterpretation.

The reflex inhibition of the heart from mechanical stimulation of the trunk of the superior laryngeal nerve or its terminal in the mucous membrane, in operations upon the larynx, such as laryngectomies, and intubations, causing the sudden collapse, even death, would, if its physiologic significance were understood, almost never occur.

The abdominal cavity bristles with circulatory reflexes. Each contact, every exposure, is a factor. The result of an operation is the sum total of all the contacts and of all the exposure. The total physiologic expense of a given abdominal procedure by one surgeon may be multiplied in the hands of another. In certain operations upon the extremities, the immediate effect may be totally obviated by the employment of a physiologic "bloc" of cocain, a procedure just as important in general anesthesia as in local. For example, operations for the excision of the shoulder girdle by "blocking" the brachial plexus may be done shock free, excepting for the minor part, represented by the division of the parts not supplied by the brachial plexus, a rather small factor.

In deep anemia, in infections, in cachexias, etc., the potential energy of the vasomotor centers is lowered. One must make a physiologic invoice of the amount of vital energy available and plan to operate within that limit. For example, in the case of acute infections, such as acute cholecystitis, large collections of pus in the abdomen of tubal or appendicial origin, leaving only a fraction of the normal physiologic margin for bearing the stress of the operation, how much safer it is

to merely open the abscess under morphin-cocain or nitrous oxide-oxygen anesthesia within the physiologic limits of safety at that moment, then, as the patient rallies, if further drainage is required, a wider physiologic margin has been acquired and a more extended operation may be performed. Finally, after the entire acute process has been safely passed, a complete clinical cure by the regular procedure may with safety be adopted. That is to say, many surgical diseases are most safely treated by an operative physiologic progression.

The field of referred pain in diagnosis is one of the most fruitful in the surgical borderland of physiology, yielding, especially in the visceral lesions, the most individualizing groups of subjective symptoms known. Recent investigations have shown that perhaps the most important circulatory changes in the acute infections are of vasomotor origin. The more accurate blood-pressure records obtained by the sphygmomanometer not only show this but they also indicate some characteristics of individual infections. Typhoid infections lower the vasomotor action, and so the blood-pressure. On the other hand, the staphylococcus, streptococcus, and colon bacillus infections cause a marked rise. This antithesis has proven of importance in the diagnosis of typhoid perforation. The blood-pressure in certain acute infections is raised by a stimulation of the vasomotor center. The futility, or may we not say the harm, of using drug stimulation in addition to the powerful toxic stimulation, must be obvious.

Consider the main facts of the circulation in acute peritonitis. The pulse is small and hard—small because a large amount of blood is localized in the splanchnic area, a regional intravascular hemorrhage—and hard because the vasomotor centers are stimulated, causing an increased blood-pressure; that is to say, the splanchnic area is flooded, the somatic area is drained. The face becomes a composite photograph of hemorrhage, pain, and infection.

A matter of surgical importance and one of the most admirable attributes of the human vital force is the physiologic compensation of one part or organ for another.

One muscle may compensate for another or a group, and a part for the whole; the loss of bones or joints may be compensated for by minimizing some functions here and exalting others there; a portion of one lung may compensate for both; one kidney, for the other. In laryngectomy, the mouth finds new vocal cords. In gastrectomy the stomach function is assumed by the intestines, and for the loss of the greater part of the latter, compensations have been provided. The rectum may act for the bladder; the abdominal muscles for a sphincter ani. Ductless glands and bone marrow reciprocate in times of physiologic distress. The range of compensation in injuries and diseases of the heart, by virtue of the compensatory assistance of the great thoracic pump, the respiratory system which alone is capable of producing a moderate circulation, is as yet scarcely considered. Note the quickened circulation, increased respiration and reabsorption of tissue fluids in compensation in acute hemorrhage. The loss by occlusion of the largest arteries and veins may be quickly met by the combined compensatory effort of innumerable smaller vessels.

The foregoing are only a few crude examples among the compensations well known, while innumerable ones of infinite delicacy and balance and vital importance are still unknown.

It is truly difficult to handicap an organ beyond some compensation, or to physiologically incapacitate a vitally strong man.

THE PROBLEMS OF SURGICAL PHYSIOLOGY.—Turning now to the problems of surgical physiology, what are they, or rather, what are they not? Among the many obvious ones we may recognize the general or the fundamental and the more specialized. Among the fundamental problems is that of knowing more definitely about that interesting property of protoplasm by which it is, in a measure, able to overcome changes in its environment; as, for example, the protoplasmic response to foreign bodies in the tissues, to various stimuli, to altered nutrition, to the effect of various drugs repeatedly administered, to changes in temperature, etc. Instead of surgical empiricisms along this line, could not some fundamental laws be established enabling us to utilize the range of protoplasmic adaptability to surgically modify, or to protect the functions? It would seem that the range of protoplasmic adaptability is at its height when the change in its environment is due to an infecting organism. In their Titanic struggle toward discovering the nature of the physiological response of tissues to infection, pathologists have turned more than half physiologists, and in this dual rôle, may we not hope they soon will solve the greatest problem in surgical physiology.

In the general problem of hemorrhage there has not, to my knowledge, been adequate investigation of the irreducible minimum of nutrition and oxygen for the survival of the various tissues and organs, since death in no two organs is produced by like conditions; for example, while a skeletal muscle may for hours be deprived of its active circulation, then resume its function with the return of the circulation, the highly specialized centers in the medulla can not, perhaps, endure a lost circulation beyond half an hour.

A splendid field for investigation would be the determination of the most practical methods of artificially prolonging the functional activity and the life of the various tissues and organs to tide over surgical crises. The reverse of this picture is also true; do we know enough of the real status of blood-letting in certain infections and poisonings? Has the action of drugs been sufficiently studied in the various grades of hemorrhage? Is the medicinal dose the same whether all the blood, or only half of the blood is in the circulation? If the effects of the drug bears a ratio to the amount of blood rather than the weight of the body, is it reasonable to give the same dosage in profound hemorrhage as when the normal quota of blood is present? The lymphatic circulation with reference to malignant metastases and infections, as recently emphasized by C. H. Mayo, is an important field.

The important problem of the surgical physiology of thrombosis and embolism has been scarcely touched.

The problem of surgical shock has been only opened, but the meager information thus far gained has already helped to throw some light upon certain immediate phenomena attending surgical operations. Physiologic chemistry should soon permit us to sustain life over crises by subcutaneous feeding.

Specialized Problems.—Among the more specialized problems the surgery of the brain presents probably the most intricate. While tremendous strides have been made in the surgical physiology of this organ, the future will no doubt show much further elaboration of the localization of the motor areas, of the physiologic adaptability of the respiratory and circulatory centers. It would seem that the accumulating surgical experience as well as the researches upon the higher brutes should lead to a possible localization of certain mental and psychical mechanisms whose representation in the brain may have localizations akin to that of motor representation. What a splendid problem is that of the investigation of the change in metabolism in tumors and injuries of the pituitary bodies. Should we not make a thorough investigation upon the medulla to discover whether or not the operative field in the base could not be extended by cocainizing the medulla and artificially maintaining the circulation and the respiration during an operation in this region, thereby protecting these centers from the numberless impulses caused by the operative trauma, tending to produce functional destruction of these centers? May these centers not be protected by cocainization until the stage of danger is passed? Would it not be possible to prevent the destructive post-operative stimuli arising from the exposed, newly-made raw surfaces by such procedure, thereby minimizing the progressive accumulation of destructive stimuli; that is to say, is it not possible to effect a functional detachment of the medulla conferring something of the degree of immunity enjoyed by the vital centers of reptilians?

In this field so much brilliant work has been done in recent years by such men as Horsley, Sherrington, Cushing, and others that it is not too much to expect still greater developments.

In the operations upon the neck we are greatly in need of more knowledge of the physiologic importance, as well as the range of possible compensations of every muscle and nerve and gland involved. We need to know, too, much more about the matter of thrombosis occurring after ligatures of vessels such as the external carotid. We also need to know more definitely about the requirements of a sufficient cerebral nutrition in the various stages of life, so that we may be more accurate in our judgment as to what patients may be subjected to a permanent closure of the common carotid artery without causing cerebral softening.

In the surgery of the thorax we have just begun to know the important problems in the surgical physiology of the heart and of the lungs. Even by our present crude methods we know that the heart may be stilled and be made to beat again almost at will. I have been able to cause a resumption of the heart beat in which there was a demonstrated cessation of circulation varying from six to twenty-four minutes. In two, the circulation and respiration resumed their automatic rôle again. In one other the respirations were not established in good rhythm. Three of these cases were suicides by drowning, two were cases of extensive crushes of the skull involving mass destruction of the brain, one occurred in the course of an operation for an extreme case of exophthalmic goitre, one while attempting to remove a tumor of the cerebral base.

With the further elaboration may we not be able to overcharge the blood with oxygen and instantly stop the heart by an electric inhibition, perform an operation upon an obstructing aortic valve, then promptly set the automatic mechanism of the heart in motion again? Even at present one might have ten minutes' grace at one's command for the execution of a cardiac technique upon a quiescent heart.

Then, again, by dint of great practical familiarity with every physiologic phase of that most persistent automatic muscle, we must, in preparation for such work, divest ourselves of the ancient and almost superstitious dread of the heart. An organ that will beat rhythmatically and do light work two days after conventional death, is entitled to more surgical confidence than has been accorded to it. I have been able to maintain a continuous rhythmic cardiac action and a complete circulation of the blood for a period of eleven hours in an animal whose medulla was detached by decapitation. Our practical knowledge of the pulmonary circulation as affecting the systemic circulation is, in our practical work, infantile. The profound impression upon the cardiac circulation by altering the intrapulmonary pressure is equal to the effect pressure upon the aorta would have upon the cerebral circulation. The Sauerbruch apparatus, as I understand it, was originally proposed with reference to the question of the collapse of the lungs, when in fact the greater risk of opening the chest is a circulatory one. The maintenance of an exchange of air on the physical principle of varying intrapulmonary pressure which affects the circulation so vitally, has an automatic adjustment so delicate that it will be found extremely difficult to substitute any artificial means. In order to protect the circulation it will be quite necessary to have control of the air pressure in both the pulmonary and the systemic circulations. This, I attempted several years ago, the results of which were published in a monograph on "Blood-Pressure in Surgery." I found that no means at my control enabled me to maintain the balance of circulation on a safe basis.

Were it possible to have the pulmonary and the systemic circulations under two separate atmospheric pressures of such delicate and efficient adjustments as to make a working substitute for the vasomotor center, a marvelous mechanism for the vital management of the circulation and life itself might be constructed.

We have seen how blocking of the nerve trunks excludes shock in operations in the regions supplied, permitting us, for example, to make an interscapulo-thoracic amputation without shock. Following this use of cocain we made a series of experiments by injecting cocain directly into the spinal cords

of frogs and dogs. We found that this block was just as effective as in the nerve trunks. The physical damage, however, prevented the application of this method clinically, excepting in such cases in which the importance of damage to the cord is eliminated. My associate, Dr. Lower, and myself were for some time hoping for a suitable case of crushing of both lower extremities requiring double amputation through the thigh. This opportunity came to Dr. Lower, who in 1898 injected the spinal cord itself and made a double amputation of the thigh without the use of general anesthesia. There was no shock and no pain, the patient making a good recovery. This is mentioned in order to call attention to the splendid possibilities of research on cataphoresis of the spinal cord. If a dentist is able by this means to anesthetize an entire dental nerve, may it not be possible to elaborate a technique whereby a cocain block may be applied to the spinal cord without any contact with this organ? The use of insulating needles would at once suggest itself. If such blocking could be established, the entire peripheral field would not only be anesthetized but rendered shock-proof as well.

The abdominal cavity is fairly distended with interesting problems in surgical physiology. The illuminating researches of Pavloff, the recent work of Cannon and others, should all be translated to the operating room in the surgery of the stomach and intestines. The problem of gastric surgery has been only opened. The physiologic disturbances incident to the operation leading to vicious circle and other complications must be more definitely solved by a better study of its surgical physiology. The infections, obstructions, and numerous fields remain unsolved.

In passing, we need only mention the supreme importance of the surgical physiology of the thyroid, the pituitary, and the suprarenals.

The surgical physiology of the kidneys is an important field.

We have in this brief outline sketched a few of the problems in surgical physiology. Anyone wishing to work in this field will not be confronted with the question what to do, but with the question what not to do. The field is limitless and has scarcely been opened.

I cannot do better than to close with Hektoen's quotation of Virchow's prophetic utterance, published in 1847: "The standpoint we aim to occupy is simply that of natural science. Practical medicine, the applied theoretical, the theoretical pathologic physiology, is the ideal we shall strive to reach so far as our powers permit. While we recognize fully the title and the independence of pathological anatomy and of the clinic, they serve us pre-eminently as sources of new questions, the answers of which fall to the lot of pathologic physiology. Inasmuch, however, as these questions to a large extent may be formulated only through painstaking and comprehensive detailed study of manifestations of disease in the living, and of the conditions in the dead, we regard the exact growth of anatomic and clinical experiences as the first and most important demand of the present time. From an empiricism of this kind will result gradually the true theory of medicine, pathologic physiology."

A NEEDLE AND CLAMP FOR INJECTING LYMPHATICS.

By WILLIAM SNOW MILLER, M. D.,

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Various aids have from time to time been devised by investigators to make the demonstration of the lymphatics easier and to do away with the hap-hazard "puncture method." None of them met the requirements of the problem which presented itself to me in my work on the lymphatics of the lung.

In the lung the superficial lymphatics are quite sizable, more easily recognized in the distended than in the collapsed lung, are thin-walled and are situated in the pleura which is spread out over the surface of the air spaces. Any lessening of tension in the distended lung will permit it to collapse to a greater or less degree, and in so doing will cause the point of an ordinary hypodermic needle to perforate the wall of the lymphatic, or, what is more unfortunate, that of the lymphatic and air space; an accident which prevents any further attempt to inject the lymphatics of that lobe of the lung.

To prevent leaking of the injection mass the needle must be tied in the lymphatic or held tightly between the thumb and fingers. This latter procedure is tiresome, prevents the use of both hands in working, and is generally impracticable; the former is out of the question because invariably the walls of the air spaces are perforated.

The point of the ordinary hypodermic needle is too sharp.[1] This fault leads to perforation or tearing of the walls of the lymphatic and consequent diffusion of the injection; an accident to be carefully avoided for it has led to some egregious mistakes. The patience of the investigator is also often severely tried by the point of the needle being accidentally pushed through the wall of the lymphatic by some slight movement and, although up to that time all has been going well, the injection is ruined.

[1] I made many experiments with capillary glass cannulæ but found them even more impracticable than hypodermic needles.

To obviate these difficulties, I devised in the winter of 1895-96 the following needle and clamp, which has served me in a satisfactory manner ever since.

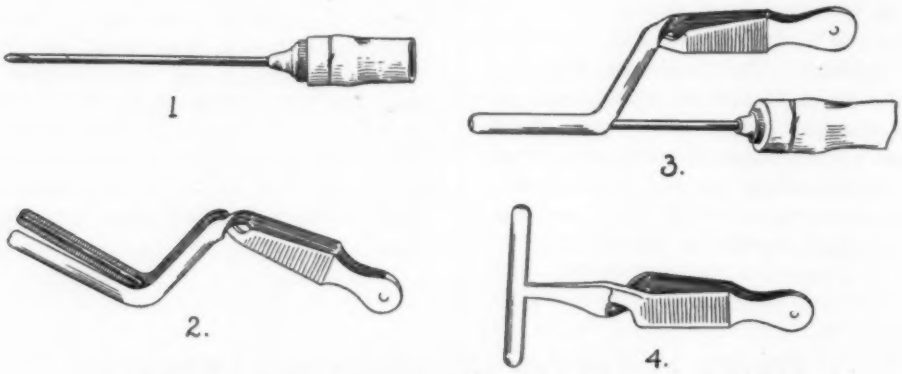
In planning the device I kept the following points in mind, viz.: the point of the needle should not have the sharp point, so necessary in the ordinary hypodermic needle; the needle should not exceed one millimeter in diameter and the caliber should be as large as possible (instrument makers differ in their expertness in making needles); the needle should be held in place by some means which would not perforate the delicate walls of the air spaces, would prevent leaking of the injection mass, and would also protect the walls of the lymphatic or the air spaces from being perforated by the point of the needle in subsequent manipulations.

Figure 1 shows the form of the needle I finally found best adapted to my use. The point is round, not sharp, and its length is greater than that of the ordinary hypodermic needle. Personally, I prefer, when using a syringe, to connect the needle with the syringe by means of a short piece of rubber tubing. This possesses the advantage of flexibility over a rigid connection and facilitates the use of the syringe. In the illustration the rubber tube is shown much too short.

The principal feature of the device is the clamp, which may be made in two forms, as shown in figures 2 and 4. The clamp is a modification of the well-known artery clamp so commonly used in all laboratories. Each arm is hollowed out (figure 2) to correspond to one-half the diameter of the needle so that when closed over the needle it is firmly held, as shown in figure 3. At the end of each arm the groove flares slightly. Of the two forms shown in the illustrations I personally prefer that of figure 2, but in some instances that of figure 4 is best adapted to the place.

The size and proportions of the needle and clamp can be modified to meet the requirements of the investigator. I have illustrated those that were best adapted to my own problem.

When using the needle and clamp the lymphatic is opened by an oblique cut made with a pair of fine, sharp-pointed scissors; then introducing a fine probe to keep the vessel from collapsing, the needle is pushed in beside the probe, which is now carefully withdrawn, and one of the clamps applied in such a manner that the end of the needle is just enclosed by the clamp, as shown in figure 3. The rounded end of the needle allows it to slide along the probe easier than a sharp point and there is almost no danger of perforation during its introduction. The advantage of the flare at the end of the groove is now seen; the end of the needle is enclosed by the clamp, but the injection of the lymphatics is in no way interfered with, and the end of the needle cannot injure the walls of the lymphatic or those of the air spaces.



The figures show the needle and clamp nearly their actual size.

I have also used the needle and clamp in injecting blood-vessels, and it has been suggested to me that the device could be used to advantage in certain bacteriological manipulations.

Examples of the work which can be done with the aid of this simple device may be seen in my paper "Das Lungenläppchen, seine Blut- und Lymph-gefässe," in the *Archiv für Anatomie und Physiologie,* 1900, and "The Blood- and Lymph-vessels of the Lung of Necturus" in the forthcoming volume of *The American Journal of Anatomy.*

STUDIES IN TYPHOID FEVER.

SERIES I-II-III.

The papers on Typhoid Fever, edited by Professor William Osler, M. D., and printed in Volumes IV, V and VIII of the Johns Hopkins Hospital Reports, have been brought together and bound in cloth.

The volume includes thirty-five papers by Doctors Osler, Thayer, Hewetson, Blumer, Flexner, Reed, Parsons, Finney, Cushing, Lyon, Mitchell, Hamburger, Dobbin, Camac, Gwyn, Emerson and Young. It contains 776 pages, large octavo, with illustrations.

The price is $5.00 per copy. Address The Johns Hopkins Press, Baltimore, Maryland.

Marcellus Malpighius Phil. et Medicus Bononiensis Collegiatus
Olim in Pisana universitate ordinarius medicinę professor Max. in
Messanensi Primarius: in Patria demum eandem profitendę ad Annum
Ętatis suę 63 a SS. D.N. Innocentio XII. eiusdem sanitatis hac
de gratia Romam accitus, ac inter intimos a cubiculo in
Aula Pontificia participantes adscriptus

MARCELLO MALPIGHI.[1] 1628-1694.

By W. G. MACCALLUM, M. D.,

Associate Professor of Pathology, The Johns Hopkins University, Baltimore.

There is in the history of medicine a remarkable contrast between two types of mind, both of which are represented by great and familiar names. Of these extremes, each of which has nearly always some of the characters of the other, one is made up of those men who, with great personal influence over their fellow-men, use what facts they have at their disposal, or more frequently what convictions are grafted in their minds to construct a theory and from the theory a system of knowledge with an explanation for all difficulties, and a niche even for such as are not yet thought of. Such men were Galen, Paracelsus, Hoffmann, John Brown, Broussais, and many more—men not always without wide knowledge, but who employ rather the deductive method than the inductive. At the other extreme were such as Hippocrates, Vesalius, Harvey, John Hunter, Morgagni, and Malpighi—men who did produce generalizations, but generalizations which were conscientiously based on real facts which they themselves had delved out of nature and which, unlike such systems as Brownianism and the physiological medicine, will last for all time. It is particularly in this character of objective observer, possessed of treasures of fact, before he signed any bond of theory, that Malpighi comes before us to this day as a model. He appeared at an epoch when such giants as Vesalius and Harvey had overthrown the universal confidence in the authority of the ancients—a period when there was suddenly work to do with no appeal to precedent—when the microscope suddenly threw open the enormous field of the minute and invisible, to the searching eye. Letters had fallen to a low ebb—ignorance was vast and overwhelming, and despite the brilliance of the preceding centuries, writers were given over to bombastic ornamentation of their writing, but a few honest and bold spirits turned from authority to nature—exact science arose.

Malpighi was one of the leaders of the movement which tore science from the bonds of tradition and the church, and rendered it independent of the ancient masters who had for so many centuries dominated everything medical.

Marcello Malpighi was born at Crevalcuore, a small town near Bologna, on March 10, 1628. Of his early life nothing is known except that his parents were small landowners who seem to have recognized some ability in their son in sending him to Bologna to study. There he entered the university in 1645 and continued his studies until the death of his parents in 1649, which left to him the care of the large family and of the estate upon which the neighboring family Sbaragli made constant attempts at encroachment. Nevertheless, he resumed his studies next year with the peripatetic philosopher Natali, upon whose advice he took up the study of medicine with Bartolommo Massari and Andrea Mariani. Of these Massari was a diligent anatomist who lost no opportunity of dissecting not only animals but human beings and who formed of his students a small society which met at his house to carry out these dissections. This academy of anatomy, founded in Bologna in 1650, was similar in some respects to the Accademia dei Lincei of Rome, and there being nine students, Massari called it the Coro anatomico in homage to the "coro" of the muses. Among them were Malpighi, Fracassati, Capponi, and Golfieri, and the friendships formed there remained strong through Malpighi's whole life.

At this time the doctrines of Galen and the Arabs still dominated the whole of medicine and teachers merely expounded the works of these authors, sometimes altering them to their great hurt. Malpighi soon appreciated the fact that Hippocrates had been a more accurate observer of nature than those later writers and devoted his thesis to upholding this view with the result that he greatly irritated his masters who, nevertheless, could not withhold their esteem of so brilliant a student.

In 1654, the year after his graduation, he married the daughter of his master, Francesca Massari—as Ferrario says, "assai virtuosa donna ma non ebbe figli." This was a very happy union, although they had no children, and she was his constant companion and support throughout nearly all of his life.

In 1656, when twenty-eight years of age, he was nominated by the Bolognese senate as public lecturer in medicine, three years after his graduation in medicine and philosophy. The liberty to give lectures thus through some animosity withheld from him for a time after his graduation, was granted apparently in connection with Massari's sudden death when he was called to the chair of medicine. In the same year, however, he was requested by Ferdinand II, the grand duke of Tuscany, to come to Pisa, there to give instruction in the science of medicine, and realizing the antagonistic attitude of his own townsmen he accepted the offer.

There in Pisa he dwelt with one Girolamo Barbato and worked happily in the sunshine of Ferdinand's favor and interest. Borelli, the celebrated mathematician and physicist, became his friend, and the two learned much from one another; Borelli teaching him the philosophy of Galileo, while Malpighi in turn imparted his enthusiasm for biological lore and his knowledge thereof. They two (later with Auber, who discovered the tubular structure of the testis), made many dissections, and the dukes and the princes attended and tempered thus the cares of state. Hence arose the famous

[1] Read at the meeting of the Johns Hopkins Hospital Historical Club, January 16, 1905.

Accademia Cimenti, or academy of experiment, which was later transferred to Florence and which, like the Accademia dei Lincei of Rome, numbered some of the most famous men of the times on its rolls.

While at Pisa, Malpighi studied the bullock's heart, macerating and boiling it until he found that the fibers run spirally, and this he at once showed Borelli. Some discussion arose later as to whether the discovery was not Borelli's, but all evidence shows that it was Malpighi who first saw this arrangement. Only in recent years has the completion of this discovery been brought about by one of our own number who showed the continuity of the muscle of the two ventricles in a double roll ending in the papillary muscles.[2]

Borelli was a man of marked genius but of irascible temperament, apparently also somewhat unscrupulous about questions of priority, but Malpighi was strongly attracted to him, and until they became estranged years afterward over a question as to the significance of respiration, regarded him almost as a father and constantly sought his counsel. In turn he was one of the few who would listen to Malpighi and approve of his iconoclastic doctrines.

After working thus happily for three years Malpighi, never in robust health and feeling the ill effects of the damp climate, left Pisa and returned to Bologna, having entered into the joys of anatomy and the philosophy of Galileo. While there he had projected a work with the aim of disclosing and remedying the evils of the medicine of that day, but this was not published and seems to have been destroyed in the fire which years later consumed his house.

In 1660 then he returned to Bologna and found Fracassati and Buonfigluoli there, with whom he resumed his studies. He became interested in the question of respiration and chiefly in the structure of the lung and the coursing of the blood through it, a process which had been shown by Harvey to take place, but which no one had as yet seen nor really comprehended. In two letters to Borelli in 1661 he describes what he has seen, urging his friend to see it too. He determined that the lung is not merely a porous mass into which blood is poured and again sucked out, but showed that the bronchi are continuous with the air vesicles and that the blood is constantly within the blood channels and never poured out into open spaces. One cannot do better than read the translation of these epistles which Sir Michael Foster prints in his interesting lecture on Malpighi, pp. 96-98:

"For while the heart is still beating two movements contrary in direction are observed in the vessels so that the circulation of the blood is clearly laid bare; and indeed the same may be even more happily recognized in the mesentery and in other larger veins contained in the abdomen. And thus by this impulse the blood is showered down in minute streams through the arteries after the fashion of a flood into the several cells, one or other conspicuous branch passing right through or leaving off there, and the blood thus repeatedly divided loses its red color and carried round in a sinuous manner is poured out on all sides until it approaches the walls and the angles and the absorbing branches of the veins.

"The power of the eye could not be carried further in the opened living animal; hence I might have believed that the blood itself escaped into an empty space and was gathered up again by a gaping vessel, and by the structure of the walls. But an objection to this view was afforded by the movement of the blood being tortuous and scattered in different directions and by its being united again in a determinate part. My doubt was changed into certainty by the dried lung of the frog which to a very marked extent had preserved the redness of the blood in very minute tracts (which were afterwards found to be vessels). Where, by the help of our more perfect glass, there met the eye no longer scattered points resembling the skin which is called sagrino but vessels joined together in a ring like fashion. And such is the wandering about of these vessels as they proceed on this side from the vein and on the other side from the artery that the vessels no longer maintain a straight direction but there appears a network made up of the continuations of the two vessels. This network not only occupies the whole area but extends to the walls and is attached to the outgoing vessel. Hence it was clear to the senses that the blood flowed always along tortuous vessels and was not poured into spaces, but was always contained within tubules and that its dispersion is due to the multiple winding of the vessels. Nor is it a new thing in nature to join to each other the terminal mouths of vessels since the same obtains in the intestine and other parts.

"All this you will see exceedingly well if you examine the turgid lung of a frog with a microscope of a single lens against the horizontal sun."

The significance of this discovery of the capillaries was of course enormous as it cleared up great difficulties not only in the explanation of the physiology of the circulatory system and respiration but especially in that of the glands, for now the function of the gland cells and the ducts could be rationally explained. As to the blood there still reigned obscurity. Malpighi, with the rest, thought the red color generally diffused, and even when several years later in his tract upon the omentum and adipose tissues he describes the corpuscles chiefly in their agglutinated condition as long rolls, he regards them as fat cells and compares them with red coral.[3]

As to respiration, Malpighi was not especially happy in his surmises, for while he rejected the view of Aristotle that respiration cooled the blood and thus kept it from coagulation—a view accepted by Descartes, Swammerdam, and even Boerhaave—he leaned to the theory of attrition, thinking the motion especially important in favoring fermentation in the blood. This was disproven by the Englishman Hooke, who opened the chest of a dog and while the heart was still beating punctured the lungs everywhere with minute holes. He then caused a blast of air to be blown through them and

[2] J. B. MacCallum, Johns Hopkins Hospital Reports, 1900, Vol. IX.

[3] Malpighi observed corpuscles in 1665; Leeuwenhoek described them in 1673; Swammerdam saw them in the frog in 1658, but his publication was in 1737.

thus, although the air leaked out of the holes he had made, the lungs were kept distended with fresh air and motionless and the dog lived for some time. An epistolary polemic between Borelli and Malpighi on the subject was probably the beginning of the rupture between them. Borelli proved that the air entered passively and that it did not entirely leave the lungs at each respiration and he had the luminous idea that the air itself was of use and that it contributed to the functions of the blood—a true divination. Incidentally Malpighi explained the frog's method of respiration which puzzled Borelli, showing that the frog practically swallows air so that respiration would be prevented by holding its mouth open—not, however, by opening its thorax.

Even at this time Malpighi was not exempt from violent attacks from his contemporaries who derided his teachings. One of his former students, Mini, who later became professor at the University of Bologna, attacked him in 1665 in a public denunciation of his teachings, and in 1678 wrote a book against him with the title "Medicus igne non cultro anatomicus," attempting to show the uselessness of anatomical studies in the cure of the sick as compared with a knowledge of the medicines which the fathers had found to be useful. Malpighi grew impatient and replied with some heat to this attack, as it is said, although I can find in his works no printed report of this reply. He must have been much comforted by the support of such men as Bartholin, Willis, and others whose opinions he knew he could respect.

In his earlier years Borelli had lived and taught in Messina and now the news came to him of the death of Pietro Castelli, who had held the chair of medicine. He immediately wrote to recommend his friend Malpighi as the most fitting successor, and the senate accepting his suggestion sent a polite letter to Malpighi requesting him to come there and teach the principles of medicine. This offer he accepted without much hesitation, and in 1662 we find him on his way via Naples to Messina. There in that most beautiful land, surrounded by the teeming Mediterranean he was in a naturalist's paradise. Every kind of animal and plant was at his service. Creatures of the sea were especially abundant and he availed himself of this profusion in marvelous fashion. Thus in the sharks he found the spiral intestinal valve and observed the viviparous habits of some forms. In the swordfish he saw that the optic stalk is composed of a twisted or folded plate, although he did not recognize the significance of this as showing it to be merely a crumpled diverticulum of the brain. He wrote at once to Borelli, who answers in a tone that seems quite modern:

"I was astounded by the drawings of the optic nerve of the swordfish, of which observations you should make great capital, and should easily find traces of this in other larger animals, such as the ox. If it prove to be so I should advise you to compose a treatise upon the subject and have it published."

It was in these fishes, too, that, without knowledge of Willis' book, he first attempted the investigation of the brain, a task so difficult, on account of the softness of the tissue which he could only overcome by the imperfect method of boiling the brain, that we can only feel surprised that he saw so much as he did. He discerned the cortical cells and their connection with the nerve fibers. Thus he appreciated the relation of the spinal cord and nerves to the brain, but unfortunately he regarded the nerve fibers as tubules (*budellini*) which carry a gross secretion from the nerve cells which he thought to have a glandular nature. This was really a Galenic idea and was soon afterward refuted, but Borelli believed it and quoted it in his book "*De motu animalium.*"

During this time Malpighi lived in the house of his interested patron Giacomo Ruffi, Visconti di Francavilla, who watched eagerly all his work and helped him in every way. It was then that he thought of writing a great work on anatomy, reviewing and criticizing all work already done and all views and theories already expressed in the light of his new discoveries. Haeser, in his history of medicine, regrets that this was never completed, but it seems now that we may feel grateful that when Malpighi consulted with Borelli and Fracassati about this, as was his wont, they wisely dissuaded him from thus examining the work of others, urging him to discover things for himself. Ruffi being of the same mind, he returned to his studies of the things themselves and nothing of the book remains except one or two chapters on the circulation and on the lungs which Atti has preserved.

During this time Malpighi's activity must have been enormous. It seems almost impossible that any one could have had time to make so many thorough studies in the intervals which elapsed between his enthusiastic epistles to Borelli and Fracassati and others by which it was his habit to announce each new discovery. His autobiography tells us, however, in the simplest concise way how he was occupied year by year.

"In the meanwhile dwelling in the country not far from the town in the villa of the illustrious Viscount Jacopo Ruffi I observed the structure of plants and there in the broken branch of a chestnut saw the air ducts or tracheæ which as I have learned exist also in other vegetables. I therefore wrote to Master Borelli about it, who answered me thus, 27 April, 1663:

"'I thank you for your description of your experience with the air tubes of plants which I have investigated too, but seeing them has not helped me further. Still I believe they are the same tubules that carry water and air and not different ones—as long as experience shall not demonstrate the contrary.'"

Evidently he made but little further study of plants at this time, for he goes on to relate how in his "horæ subsecivæ" he dissected fishes and other creatures, including various quadrupeds. It was then that he turned his attention to the tongue and its papillæ, which were of course well known, but thought to be secretory in nature. This he readily showed to be untrue by allowing the tongue to protrude and dry, when no secretion appeared from the papillæ. On the other hand he was able to show their provision of nerve filaments

and to deduce from this their gustatory function. Further he recognized the analogy between these and the papillæ of the skin, which he studied—one may say discovered. Particularly was he interested by the rete mucosum which he saw first of all and of which we speak in his honor as the Malpighian layer. There, as he pointed out, accumulates the pigment which makes the negro black. The nature of hair, feathers, and the external layers of the skin also fell under his inquiring search, although Leeuwenhoek perhaps described the epidermis more accurately in later years.

In 1665 he was violently attacked by one Michele Liparo, who upheld the ancient Galenic writings against the modern and published a book full of error and slander against Malpighi called *"Il Trionfo dei Galenici."* Malpighi, assuming the name of one of his students, Placidi di Papadopoli, answered him in an epistle *"Il Apologia dei Moderni,"* which Fracassati and Borelli wished him to publish, but which by his own will was not printed until the appearance of his posthumous works. This epistle, which begins with a harangue upon the ingratitude of mankind which neglects to read the great book of nature and leans upon authority, goes on to a great length discussing acutely the works of Galen and the interpretations put upon them by those who bow to his dictum.

It must have been during this time, although it is difficult to gather it from his autobiography, that Malpighi collected together his notes or made the new studies upon the viscera and their minute structure which forms the material for his book *"De Viscerum Structura Exercitatio Anatomica,"* which was printed in 1666 in Bologna. He writes: "The fourth year of my stay slipping by and the curriculum of lectures being completed I meditated a return to my own country. But it pleased the illustrious senate of Messina to request, on April, 1666, that I should continue yet another four years and with this in view I started to Bologna in the beginning of May with the plan, health, and my domestic affairs permitting, of returning in the autumn. In Naples I met the learned Cornelius and Leonardus and others of that school and talked and consulted with them as long as I was able, to the great recreation of my mind. In Rome it was my fortune to meet for the first time the famous Nicolao Stenone, who was very suave and friendly . . . and many others and at length reached Bologna safely. After a short bodily rest I had printed the material which I had arranged concerning the structure of the viscera."

This tract, printed separately at least once again by Petrum le Grand in Amsterdam in 1669 and finally in the various editions of his complete works, is one of great interest. It contains essays on the liver, the cerebral cortex, the kidneys, and the spleen, and each of these essays added much to what was known of the anatomy of these organs—indeed they shed the first clear light upon them. Malpighi apologized for writing of the liver after Glisson had written so well, but his contribution, notwithstanding that Glisson had written, is of great importance. He recognized the structure of the liver as that of a conglomerate gland, composed of hexagonal lobules, the number and structure of which he left to others to discern. He decided, too, that the bile-duct is the ordinary secretory outlet of the liver as in other glands their ducts, and that the bile is actually secreted by the liver and not by the gall-bladder. All these were important advances on the ideas that referred to the liver, chiefly the function of blood formation.

The essay on the kidneys is a masterpiece. Naturally he knew well the work of Lorenzo Bellini, who, in 1662, described the masses of tubules which make up the cortex, and began with this idea, soon discovering that the tubules are not straight but greatly twisted. He studied the form and general arrangement of the various tissues in the kidneys and we still hear his name in connection with the pyramids, although others must have known them before. He was the first to see the glomeruli, which also bear his name and which he correctly interprets as small tufts of vessels, for he could inject them either from the artery or from the vein. He describes them as hanging from the vessels like apples on a tree. The nature of their connection with the tubules was only explained clearly by Bowman much later, but Malpighi knew that they were connected and attempted to force colored fluids through them into the tubules but with no success. He also injected colored fluids into the ureter and in the living animal tied simultaneously the ureter and veins but without results of which he could be quite sure.

In the spleen he found "glands or vesicles distributed through the whole spleen like bunches of grapes. These have an oval form and are not much larger than the glands of the kidneys. They are, as I always observed, white, and even if the vessels are made turgid with a black injection, they preserve their color. They are soft and friable and one can see no cavity in them." He described also the vessels, parenchyma, trabeculæ (which he thought to be muscular), and the capsule and ligated the splenic artery in the dog without apparent effect.

To this there is appended a rather long description of the masses found in the heart after death and entitled *"De Polypo Cordis."* Evidently these were only postmortem clots, and even at the time Kerkringius, in his anatomical observations, contends that it is absurd to think that such masses were present in the living heart. Much more probable is it that they are produced in the dead by the cooling of the blood and the action of acids and other substances. The same mistake has recurred up to our own times and there is still alive a famous Anglo-Indian physician who has described, with vivid regret, the untimely death of many young soldiers and others from the development of such masses in the heart.

On his return to Bologna, despite his intention of going back to Messina in the autumn, he was persuaded to stay, and announced his intention to the senate at Messina, who, having already written to hurry him back, then answered accepting, though unwillingly, his resignation, which they took in very good part, wishing him every success and joy.

Thus he writes: "My domestic affairs being arranged and the house in Bologna settled, I went on with my studies with quiet eager mind." He practiced medicine, lectured, made autopsies with the aid of Fracassati and Buonfigluoli and earnestly sought the causes of disease. Besides these occupations he sought the society of friends and especially those of foreign cities, among whom were Sylvius de la Boe, Willis, and Bartholin, and tried by conversing with the celebrated men who passed through Bologna to advance his anatomy and to learn of remedies.

After this he turned his attention to the study of the lymph glands and of the uterus and its appendages. He was the first to describe the Gärtner's ducts as Gärtner himself stated in his description. This was not all, however, for he saw the uterine glands, studied the placenta which gave him difficulties, saw the Graafian follicles or ova and was the first to describe the corpora lutea. Again, he interests himself in the structure of bones, describing the flat bones especially noting that some bones contain no fat but blood—red marrow—such are the ribs, bones of infants, bones of birds, etc. He saw a cranium among the treasures of the Duke of Modena which was strangely thickened and curved with nodular projections, polished, and white like ivory. This skull he describes in the minutest detail as well as another in which he evidently had to do with a case of osteomyelitis of the jaw with sequestrum formation. Interesting, too, is his description of the aorta of the eminent Cardinal Bonacairsi, which was greatly dilated and lined throughout with bony plates and which he thinks might in time have become a continuous bony tube, as has already been observed in others. In another he describes the plaques as like drops of wax. These evidently contained no lime for they burnt readily into a black ash. He has also seen such plaques of bone in the meninges, and in the uterus and in the testicle has found stone-like masses, probably of the same nature. Thus, also, by the inspissation and precipitation of such materials he explains gout-stones. Next he is concerned with teeth and describes the teeth of a great variety of creatures, recognizing the different elements which compose them and describing the enamel as substantia filamentosa. About this time he tells us he became acquainted with Meibomius, Abraham Vilna, Joachim Elsner, and others.

Then, in 1667, he received a letter from Henry Oldenburg, the secretary of the British Royal Society, expressing their appreciation of his worth and asking him to correspond with them, to send them his works about plants, minerals, insects, particularly about the silk-worm, and to let them know of the works of other eminent writers in Sicily.

Malpighi answered with what he could of the unedited work of P. Costelli, Maurolicus, Borelli, and others, and set himself to work in 1668 at the cultivation and study of silkworms, "in which I tried to show not only the external mutations but the relations and structure of the viscera. This was a most tedious and laborious task, and fatigued by months of toil I was seized with a fever and an inflammation of my eyes in the autumn. Still, notwithstanding these difficulties, there was a mental delight in this work—in finding so many and puzzling miracles of nature that I cannot describe them with my pen. My collected observations, with drawings, I sent in the beginning of the year 1669 to the Royal Society."

In this dissertation he described what he saw in watching day by day the silk-worms which he hatched, and dissecting them at various stages. The minuteness and accuracy of his observations are astounding as he goes on to describe the external form, the musculature, the tracheæ, the nerves, heart, intestines, etc. Then the metamorphoses and the structures and habits of the adults. The generative organs and egg-laying occupy much of his attention, and all is set forth in the same clear, definite way. Particularly instructive are his references by way of comparison to other insects in which the structures differed slightly. The silk-spinning apparatus he describes and pictures in detail. Especially interesting, too, are his experiments with the tracheæ to prove their respiratory nature. If one apply oil so as to close them the animal dies. That this is not the poisonous property of that particular oil he shows by using other oils or even honey, relating that the creatures after any of these applications die in convulsions, while one may say a paternoster. When they are immersed in water and then allowed to dry they may recover when the water has dried off the orifices of the tracheæ. Much of his information on the silk-worm, including his observation that the eggs do not develop unless they have been mixed with the sperm of the male, was published later in his posthumous works in a letter to Buonfigluoli, etc.

We may here mention his work in connection with other insects, although much of it was not published until many years later. Cattaneo, who has written in an interesting way of Malpighi's studies of comparative anatomy, has collected together what he has written of insects. It was Malpighi who really discovered the tracheæ of insects and also the tubular heart which beats backward through the body, and about which Swammerdam disputed with him. The excretory tubules which hang about the intestine are his very own, too, and bear his name. He regarded them as hepatic in nature, although their real excretory character has since been shown. He drew with care the segmental muscles of the locust and of the pine caterpillar, and in a letter to Bellini in 1689 he actually describes their striation. The nervous cord, with its ganglia and pericœsophageal ring, the compound eyes and tactile antennæ—all these he described, and he even spent time on ascertaining the nature of the firefly's light, which he thought due to a sulphurous humor, since it gives a humid light which shines even under water. His crowning work on entomology, however, for which the studies of all these other insects were by way of preparation was the description of the silk-worm.

Even before the publication of this work was well under way he bought a villa nearby, at Corticella, and left his chair in Bologna to retire to the country and to study plants. Evi-

dently, however, this did not entirely preclude his indulging in the dissection of all sorts of animals. Everything that fell into his hands was dissected, even the creatures that came as food into his house were sacrificed first to his passion for dissecting, but as there was as yet no rational classification of animals his dissections were more or less isolated, for him at least, and he cannot be regarded as a founder of comparative anatomy except in the sense that he furnished an enormous material for others to analyze and correlate.

In 1669 Steno came to Bologna to visit him, and while he was there Malpighi showed him the muscles of the eye of a bird. Unfortunately it was not until after Steno had gone that he saw in the eye of a screech owl which he had opened laterally the inverted image on the retina—" trees, the house, —all inverted and whatever was at the right now came on the left."

Malpighi tells us in his autobiography that now having written of the structure and relations of the organs of animals he turned to the study of the anatomy of plants as being simpler and possibly capable of throwing light upon the other. Accordingly, after two or three years, he had published by the Royal Society the " Idea Anat. Plantarum," which was a sort of preliminary communication which expressed all the principles and the essential discoveries which he related in detail in his later work, the " Anatomes Plantarum." Curiously enough the " Idea Anatomes Plantarum," with its description of tracheid vessels, etc., was read at the Royal Society in 1671, just as Nehemiah Grew's work on the same subject appeared from the press. Grew described the tracheid vessels too and thus might claim the priority but he magnanimously resigned that to Malpighi, for he knew that he had made his observation in 1663.

For an idea as to the condition of botany at this time I may draw on Morini's interesting analysis of Malpighi's botanical work. Up to the time of Linnaeus and Tournefort the codex of botanists was the *Pinax theatri botanici*, the work of forty years of Gaspar Bauhin's life. It was the result of the feverish search of the Germans and Italians for the simples or plants described by Theophrastus, Dioscorides, Aristotle, and Pliny. Then, in the sixteenth century, there arose the botanical gardens; first in Padua, established by Bonafede and da Monte; then in Pisa, Bologna, and in 1577 in Leyden. No rational method of studying plants had been devised, however, until the time of Conrad Gesner, who knew them by their flowers and fruits and in this way gave the basis for the elaborate classification of Linnaeus. Cesalpinus was a botanist, too, as we see by his book (*De Plantis, libri* xvi, 1583), but they were yet in the beginnings of botany. Analogies, real or supposed, with animals dominated their ideas and the pith was regarded, therefore, as the seat of the vital principle, etc. Malpighi, too, clung for a long time to the idea that a circulation exists in plants comparable to that of animals and searched for valves in the conducting tubules. He had also the idea that there was a widely ramifying vessel taking food to all parts of the plant, and as he thought (having seen laticiferous and resin-bearing vessels) that he had surely seen this in some plants, hastened to apply the idea to all.

It would be impossible to enter into the details of Malpighi's enormous work which concerns especially phanerogams, but also some pteridophyta, fungi, galls, and parasitic plants. Hooke had seen plant cells and regarded them as merely cavities partitioned off from the general cavity. Malpighi, however, made a distinction between cells and fibers and vessels. With rare perspicacity he saw that all plants are composed of a complex of sacs or vesicles which constitute the fundamental tissues, and these he called otricoli. The generalization of this principle manifests the synthetic power of his mind. He had thus arrived at the modern distinction between parenchyma and prosenchyma, further than which he could scarcely go without a knowledge of protoplasm and the possibilities in the modification of cells.

His recognition of the continuity of leafstalks, branches, stem, and roots, and of the fact that the floral envelopes and cotyledons are modified leaves brought him very near to the ideas of Wolff and Goethe that all the diverse plant products may be traced from a few single types.

He described minutely with drawings of sections studied microscopically the wood and bark, the medullary rays, the tracheid vessels, scalariform and pitted vessels, sclerenchyma and woody fibers, the medulla, the nature of the annual rings, and so on, but erred in ascribing the origin of the wood fibers to the bast. From watching the growth of many plants he concluded that there was an essential difference between those which grew with one cotyledon only and those which started with two and thus divided as we now divide them, the phanerogamous plants. Not only this but he recognized that there is a fundamental difference in the arrangement of the fibrovascular bundles which corresponds with this division.

Most of his studies were, however, not merely morphological but sought to explain the physiology and laws of development of plants. Up to his time Cesalpinus had regarded the stamens as a means of draining the ovary and thought that the purified ovary could then produce seeds. Malpighi probably did not actually see the fertilization in the flower, for in studying the embryo he missed the micropyle which Grew had seen. Nevertheless, his work on the development of the ovum into the seed and of the ovary into the fruit and then of the germination of the seed is classical.

He recognized the need of air for plants, and again with his zoophysiological ideas ascribed the function of carrying the air to the tracheids. He found that on submerging them in water covered with a layer of oil they all putrefied and further that they died if he stripped them of leaves. Still he could never find the stomata of leaves and did not recognize the function of the chlorophyll, thinking that the gas exchange was equally carried out by the bark and the pith.

By ringing the stem of a plant he discovered the return current of elaborated materials from the leaves.

The sudden appearance of all this knowledge as to plants at a time when only the wildest speculations had resulted from what little thought had been expended upon them is another evidence of the great originality and independence of Malpighi's mind. His generalizations, too, from his various observations show the touch of genius which is missing in Grew's ponderous work. With the lower plants Malpighi concerned himself less. Rusts and smuts attracted his attention and he recognized the sporangia. In the mosses, too, he saw the sporogonia with the peristome and operculum and recognized the spore nature of the dust which one can shake out. Mucor and other moulds he studied too and saw their sporangia if not their spores. Apparently he was the first to describe the tubercles produced by nitrifying bacteria on the roots of leguminous plants, which have roused such interest in late years. Spontaneous generation was generally taught and believed in, but Malpighi took earth from a great depth, put it in a glass vessel which he covered with several layers of silk so that air and water but not the smallest seed could enter. Nothing grew. This seems a remarkable foreshadowing of Pasteur's work and we may imagine with what delight Malpighi would view a modern thermostat with its cultures of bacteria. Of infusoria or any microscopic plants he tells us nothing.

Although we have thus gone on to describe his botanical work at this point, it was not all the work of a year but lasted over several years, and while the *"Idea Anatomes Plantarum"* was published in 1671, the first part of the *"Anatome Plantarum"* appeared in 1675, and the second part, also published by the Royal Society, not before 1678.

In the meanwhile he was not neglectful of his anatomical interests and in an incredibly short time, amid his other occupations, he watched the hatching of hens' eggs, studying the developing chick at every interval by spreading it out on a glass slide and viewing it with his microscope, until in 1672, there was printed the book *"De Formatione Pulli in Ovo,"* which may perhaps be regarded as the cornerstone of embryology. This paper was sent to the Royal Society in February, 1672, but in October of the same year he finished another paper on the same subject, *"De Ovo Incubato,"* which enters much more fully into the details which he observed day by day in subsequent series of chicks. With his new method of floating off the embryo in water and spreading it on a slide, Malpighi was enabled to make many advances over his predecessors, of whom perhaps Harvey ought specially to be mentioned. Evidently, as he himself says, he entered into a very chaos when he undertook the study of this subject. Since he had no other method and seems not even to have dissected his embryos except in the latest stages but to have depended most largely upon their transparency, it is surprising to find how much he actually did see and draw in his figures. Hour by hour he described the changes which he could observe and later day by day. The accuracy and lack of error in his descriptions and drawings is quite marvelous, but it will be necessary to mention only the chief points. The formation and closure of the medullary groove, the primitive metameres, and the formation of the cerebral vesicles are clearly shown. Then the appearance of the optic vesicles with their stalk, the cleft in the vesicles, and later the lens formation are traced out. The twisting of the body and the appearance and development of the heart from a single bent tube to the perfect arrangement of auricles, ventricle, aortic arches, etc., are described, and the question arises in his mind as to whether the blood or the heart appears first. Later in his posthumous works he abandons this query as not worth labor. The division of the primitive portions of the brain is dwelt on and the modifications of each part described. With the later changes, owing, perhaps to the loss of transparency, he is less fortunate. There is a vague description of the liver, the clear white lungs, and the other organs. I can find no mention of the development of the intestine nor of the generative or renal apparatus. The appearance of the wings and legs and of the protuberances that later produce the feathers, and the feathers themselves are minutely followed. The breaking out of the egg, too, and the constriction and separation of the umbilical vesicles are as clearly described as in any modern book.

During this time he was attacked by many jealous enemies, even among those of his own faculty of Bologna, and so fiercely that Cardinal Pignatelli felt it his duty to interfere and protect him. Among these most prominent was J. Hieronymo Sbaragli, who, in an epistle "De Recentiorum Medicorum Studio, Dissertatio Epistolaris ad Amicum" (Göttingen, Sept., 1687), again, like Minus many years before, ridicules the studies of Malpighi, both anatomical, zootomical, and botanical, on account of their inutility in furthering the cure of disease. Of what use, he says, is the knowledge of the structure of the lung and the streaming of blood through it. Everybody knows that animals breathe but no one knows why, and it may be said even that in this modern seventeenth century, with all this new knowledge at our command, we are not even quite as successful in curing pneumonia as were the fathers of old. Everyone thought, until the work of Wirsung, that the pancreas was just a cushion to support the stomach. What better off are we to know that it has a duct? Above all of what use to cut up plants and study the hatching of eggs? Can one cure the troubles of women, knowing how the hatching of eggs goes on?

Malpighi replied somewhat querulously in a very long letter in which he republishes Sbaragli's epistle, then taking up clause by clause his objections. What difficulties must have met Malpighi in answering those taunts in those days when he could not persuade his readers of the future of his discoveries, even though he could see it himself, and how completely he has been justified. In our times the situation is different. Great good has been shown to come from some of these seemingly irrelevant discoveries and now everyone is willing to believe in such apparent side-paths of research and to wait hopefully for the practical result. Still Malpighi was not without a response. Precisely in the case of the

pancreas he recounts the knowledge of the day, saying that the secretion poured out from that duct, mixing with the bile and the chyle "provokes a peaceful fermentation," and that if it be prevented from so flowing or its character destroyed the person will waste away in an cachexia and that here at once we have a new knowledge of the cause of a disease. Of the hatching of the egg he immediately points to the hydatidiform mole and the abortions which are examples of the results of disturbance in this development. It was the fault of the times that such a ridicule could come to him—not the fault of his honest work.

The quarrel with the Sbaraglis, which lasted throughout Malpighi's life time and which concerned at first their adjoining estates and afterward, as we have seen, the doctrines of Malpighi, was marked by shameless acts of violence on the part of the Sbaraglis and even went so far that one of Sbaragli family was killed in an encounter with Malpighi's brother Bartolommeo.

It was about this time that he thought of collecting all his works and publishing a corrected edition. Then it was, too, that he wrote his autobiography which appears in his posthumous works and from which most of the details of his life have been learned. In this journal, which was by no means so detailed as his diary which he kept regularly from 1660 to 1694, he relates the main events of his life and discusses his works, criticising them and giving in full the criticisms of his contemporaries and his answers. He freely points out the weaknesses of his works and as freely acknowledges the good work of others.

In 1680 Malpighi sent his portrait, painted by Tobar in oil, to the Royal Society with a complimentary letter. They put it up carefully in a frame and Malpighi wrote to thank them for their care.

In 1683 he sent them a letter on the structure of the uterus, on a malformed kidney, on horns, glands, etc. The epidermal structures had long interested him and he devotes himself for a time to the study of hairs, feathers, and horns, studying the latter from their embryonic state in the bull and even describing a curious case in which a horn developed in the neck of one of these animals.

In the next year a fire broke out in his house, the villa at Corticella, and destroyed it completely together with many of his cherished possessions. A letter to Redi, which is published in his works (Opere de Fr. Redi, 1811), gives us an idea of the desolation into which he was plunged by this disaster: "I live, if it can be called life, in idleness, without other aim than to distract my grief. A chance fire in my house in the last month has burned what little I had, my notes in manuscript, the microscopes and lenses—only one was saved and a short time afterward this was stolen from me with a little money. I must recognize in this the voice of heaven, the more that to my old ills there are added articular pains which fetter me close so that nothing remains to me but to study and enjoy as best I can the work of others."

The correspondence with the Royal Society was interrupted from this time, 1684 until 1688, when they sent him a letter saying that they held him in high respect and asking for his most recent discoveries. He responded with the "*Epistola de Glandularum Conglobatarum Structura,*" in which he describes the distribution of these masses in various animals, their consistence, form, and color and their relation to the blood-vessels. He recognized, too, that they formed a portion of the lymphatic system and were directly intercalated in the lymph channels, although, as he tells us, these channels are so delicate and friable that it is practically impossible to dissect them out or even to obtain a very satisfactory injection. He names them lymphatic glands and goes on to describe some pathological changes, such as tuberculosis of the gland which can be recognized from his description, but which he also designates as tuberculosis, describing the relation of this lesion to the analogous condition in the lung.

Malpighi was now sixty years old, and after this there was hardly anything more of importance from his pen. It is true that he wrote, as we see in his posthumous works, notes upon flukes and tænias which he found in various animals, but they are not particularly happy descriptions. In the tænias he saw the suckers which he regarded as eyes with closed lids and the hooklets which he thought the teeth about the mouth; he could see no intestine, but the uterus with its eggs he saw, although he did not interpret it.

In 1691 he was asked by his old friend Cardinal Pignatelli, now Pope Innocent XII, to come to Rome to be his archiater or personal physician. Malpighi hesitated, partly on account of his ill health, partly because he had no taste for the position, but the pope would take no denial, and he set out for Rome. His autobiography tells us nothing of the period which followed this. He left Bologna, though, amid the general regret of the people who were loud in their expressions of affection and admiration, and reached Rome where he was received with profound respect. In 1693 Waller, the secretary of the Royal Society, wrote to congratulate him on his new position, and Malpighi answered, later writing to describe the earthquakes in Sicily. In July, 1694, he had an apopletic attack, the nature of which he recognized. It filled him with gloomy forebodings of his approaching end and he hurried to put in order his worldly affairs and to collect his notes—the notes which later appeared in his posthumous works. In November another attack came upon him as he had foreseen. On his deathbed he instructed de Fabri to send the rest of his manuscript to the Royal Society, and this wish was carried out by Buonfigluoli, his lifelong friend. They were properly printed by Churchill in 1696, and twenty copies were sent to Buonfigluoli. Malpighi died on November 29, 1694, in the Palazzo Quirinale. To Baglivi fell the dolorous task of performing an autopsy and embalming the body, which was afterward transported to Bologna and buried in the Church of San Giorgio. Baglivi's report is concise and I may repeat it here:

"Marcellus Malpighius ann. aetat 66. circiter, temperamenti ad siccum vergentis, mediocri corporis habitu, & mediocri pariter statura praeditus; cum per decursum plurium virilitatis suae annorum obnoxius fuisset vomitibus & secessi-

bus biliosis, & post horum suppressionem vomitibus acidis, palpitationibus cordis, calculis renum & vesicae, urinis cruentis, & interdum affectionibus podagricis levioribus: demum exacerbatis his omnibus post illius adventum Romam, praesertim palpitatione cordis, calculi renum, & sudoribus quibusdam vespertinis, iisque mordacissimis, correptus fuit apoplexia 25. Julii ann. 1694, hora circiter meridiana, praecedentibus curis, & animi passionibus, &c. Apoplexiae accessit paralysis totius dextri lateris corporis, tortura oris & oculi pariter dextri, &c. . . . . Die 29. mensis Novembris ejusdem anni denuo correptus fuit apoplexia post injectum consuetum clysterem hora matutina. Novam hanc apoplexiae invasionem praecesserunt gravissimae vertigines cum exacerbatione calculosa vesicae fere per integrum octiduum; inappertentiae, & reliqua symptomata antedicta graviora erant: sed vehementior his omnibus fuit novae apoplexiae insultus; nam irritis quibuslibet remediis post quatuor ad invasione horas, migravit ad superos.

"Sectio Cadaveris.

"Secto cadavere observavi, sinistram pulmonum partem aliquatenus flaccescentum lividam, praesertim inposteriori illius parte, qua dorso adhaeret. Cor erat mole sua auctum, & praecipue parietes sinistri ventriculi, qui duorum digitorum latitudinem aequabant. Bilis in vesica fellea valde nigricabat: Ren sinister in naturali statu erat, dexter contra quasi medietate minor sinistro, ejusque pelvis adeo dilatata, ut duo digiti commode intrudi possent: ob hanc pelvis dilatationem succedebat, forsan ut calculi in renibus geniti statim in vesicam descenderent, & e vesica foras prosilirent, ut pluries mihi testatus est, dum esset in vivis Vir optimus. In vesica urinaria parvus calculus aderat, qui quatuor diebus ante invasionem ultimi accidentis apoplectici inibi descenderat, & descendendo vertigines illas ultimas exacerbavit. Reliqua viscera naturalia optime se habebant.

"Aperto capite, in cavitate dextri ventriculi cerebri duas libras circiter sanguinis nigri & grumosi extravasatas invenimus, quae sanguinis evasatio apoplexiae causa fuit & mortis. In sinistro ventriculo residebat aqua sub flava ad pondus sesquiunciae, eique intermixtae erant minimae arenulae exigua quantitate. Vasa cerebri sanguifera erant undequaque varicosa. Universa dura mater fortiter ac praeternaturaliter adhaerebat cranio."

Even more detailed and interesting is the account of the personal history of Malpighi which we find in the note of J. Marie Lancisi, which is printed in the Proceedings of the Royal Society and which I may repeat in full:

"The incomparable Malpighi who industriously applied himself to very serious Studies was of a good Habit of Body and had seen 66 Years, but he had frequent Sicknesses; Sharp Vomitings did torment him for 20 years. He was troubled with the gravel, a Hæmorrhagia in the Kidneys, a Rheumatism fluxious which with the troublesome consequences augmented his Infirmities. Scarce had these Evils given him some Respite when a cruel palpitation of the Heart with an unequal Pulse came upon him. Moreover 4 years before his death a sharp and biting sweat failed not all the summer to trouble him every night. Pope Innocent XII having called him to Rome to make him his chief Physician he began the first year to lose his fresh Color. In the second he voided many Stones without much pain and in the third which was the last of his life he found himself oppressed during the Winter with a difficulty of breathing.

"His health being thus insensibly undermined and a bilious looseness returning ever and anon he was at length seized with a Vertigo and loss of speech and Contorsion of the mouth (Spasmus Cynicus) and a palsy of half the right side, and tho there was appearance that he was out of danger by Bleedings, Purges, Diuretics, Antapoplectic medicines, yet one might see by his melancholy countenance but especially his want of memory that there was lodged in his Brain some melancholy Humour. Therefore perceiving his end drawing near, he signed with his Hand 3 days before his death his Posthumous works which he had ordered to be delivered to his Colleagues of the Royal Society at London. Then having confessed himself with great humility he attended generously with faith in God the death which appeared to him certain and not far off and on the 28th of November, 1694, a terrible apoplexy finished in the space of four hours this so precious life.

"The learned man foresaw that he should end his days by an Apoplexy and therefore forbad his friends to open his body until 30 hours after his death for he knew well enough that some who seemed dead on a sudden have revived some hours after. When he was opened we found the bladder of Gall abounded with a black Gall. The left kidney had nothing amiss but the right was twice as little and had its Pelvis twice as big which discovered the cause of the easy descent of the stones. We found in the bladder a little Stone that seemed to have fallen into it a few days before. The Lungs appeared withered with some mark of corruption on the back side. The Heart was bigger than ordinary, and the sides of the left ventricle felt harder and thicker in some places than in others. Yet there was no polypus found in it.

"The right ventricle of the Brain contained almost two ounces of extravasated blood and the left ventricle was swelled with a thick and yellow sort of Phlegm which weighed more than an ounce. Moreover the dura mater stuck closer to the skull than is usual. This proves that the conglobated glands in the whole body had thrown into the mass of the blood an acid lymph, and that the conglomerated glands of the hypochondria—especially those of the liver had thrown into it a melancholy humor and that these two sorts of humors being carried into the vessels of the Brain had disposed the blood to coagulate there, and that having there corroded and broken the tunicles which served for a stop to them they had run into the cavities where they caused death without a remedy.

"J. Marie Lancisi."

It is difficult for any one person to form a just estimate of

Malpighi's worth because his activities, like those of Virchow, ramify into so many widely different researches that there are few even at this day who can appreciate their details. Anatomy both human and comparative, physiology, general medicine, embryology, and botany—these, together with a minute study of entomology in both its anatomical and physiological aspect, were the things that occupied his mind. We cannot but regard his anatomical discoveries as of the first importance, and chief among these the capillary circulation and the explanation of the structure of the various viscera. His other numerous discoveries form a mass of new facts, such as it has been the fortune of scarce any anatomist to produce. Together, with his embryological studies, they form the basis for the great principle of the fundamental similarity among animals and the repetition of the principles of biology in the ontogenesis of various creatures.

In his botanical work he has always been compared with Grew, whose similar work on the same subject appeared at the same time. Sachs in his "Geschichte der Botanik," contrasts the two, pointing out that while Grew spent his whole life on phytotomy and amassed a quantity of facts, theorizing only too profusely on them, Malpighi tells us in a genial conversational style of his observations without undue surmises or philosophy.

After all is considered the most enduring things in Malpighi's books are his perfect honesty, his extraordinary keenness and good sense in the interpretation of what he saw and, his ingenious objective methods of observation. What he saw could not have failed of being seen very soon by others, but we are filled with wonder that quite alone, with his "quiet eager mind," he could have encompassed all, steadily searching out one thing after another throughout his forty years of restless activity.

TYPHOID APPENDICITIS WITHOUT OTHER INTESTINAL LESIONS.

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The recent study of the bacteriology of appendicitis has demonstrated the presence of a variety of micro-organisms in this condition. While it is not our purpose to enter into a lengthy discussion of the bacteriology of this disease, yet we shall briefly refer to the principal bacteria found in this process.

In "The Vermiform Appendix and its Diseases," by Kelly and Hurdon, the various organisms found in appendicitis are mentioned. The principal aërobic bacteria are *B. coli communis, Streptococcus pyogenes, Staphylococcus aureus, B. pyocyaneus, B. vulgaris, Pneumococcus, B. lactis aerogenes, B. alcaligenes,* various members of the hog cholera group, the *B. Friedländer* and the *B. pseudo-diphtheriæ.* It is not thought that all of these are the primary causes of appendicitis. Probably *B. coli, B. pyocyaneus,* and *Streptococcus pyogenes* are the most frequent causes of inflammation of the appendix. The *B. tuberculosis* and *Actinomyces hominis* produce special infections of the appendix.

Quite a number of anaërobic bacteria are mentioned by Lanz and Tavel[1] as occurring in appendicitis, but it is difficult to determine just what part they play in the actual production of the disease. Among the known pathogenic anaërobic bacteria they mention *B. aërogenes capsulatus* and the *B. edematis maligni.* Others mentioned are *B. pseudo-tetani,* and *B. ramosus, B. fusiformis,* and *B. furcosus.* These anaërobic bacteria may act as secondary invaders, producing principally gangrenous appendicitis. For an excellent account of this subject one should consult Kelly and Hurdon's book.

[1] Revue de Chirurgie, 1904, Vol. XXX, pp. 43-215.

Appendicitis and Typhoid Fever.

Although simple appendicitis and appendicitis with the characteristic lesions of intestinal typhoid both occur in this latter disease, as yet we have been unable to find any records of an uncomplicated primary appendicitis from which the typhoid bacillus has been isolated.

Hapfenhausen,[2] cited by Kelly and Hurdon, has investigated 748 cases of appendicitis, and in 36 of these cases there was a history of previous typhoid. The date of the typhoid ranged from two months to 40 years before the attack of appendicitis, and two other post-typhoid appendicitis cases are described by the above authors.

Routier[3] observed a case of appendicitis which terminated in an abscess, and which followed typhoid fever, and Anghel[4] reported an appendicitis following an attack of tonsillitis during typhoid fever. Dominici and Letulle[5] produced this disease in rabbits by injecting the typhoid bacillus into the ear vein, and Adrian[6] caused thrombi, hemorrhages, and necroses in the lymphoid follicles of the appendix in a similar manner. Mühsam,[7] by first crushing or bruising the appendix in rabbits, was able to produce inflammation of the appendix by injecting one cubic millimeter into the ear vein.

It will be seen from these clinical and experimental reports that appendicitis must often be associated with the typhoid

[2] Rev. de la Suisse Rom., 1899, tane 19, p. 105.
[3] Semaine med. No. 1, p. 6, 1897.
[4] Anghel, Thèse de Paris, 1897.
[5] Semaine med. No. 10, p. 73, 1899.
[6] Mitt. aus d. Grenzgebiet. d. Med. und Chir., B. VII, p. 736, 1901.
[7] Deutsche Zeitsch. f. Chir., Bd. 55, H. 12, p. 143, 1900.

bacillus. Our case, however, seems to be one of primary typhoid appendicitis, unassociated with any recent intestinal lesions, and as the typhoid bacillus was obtained from the lesions, we have thought it of interest as bearing upon the subject of typhoid infection and appendicitis.

Clinical History of Case.

The case which we wish to report was that of W. D. M., a medical student 24 years of age.

His previous history showed that he had a very severe attack of typhoid fever thirteen years before his present attack of appendicitis. Several other members of his family were attacked with typhoid at the same time, and all recovered.

On March 21, 1905, at 6.30 in the morning, he was attacked with a severe pain in the entire abdomen, which later became localized in the right iliac region. This was followed by nausea, vomiting, and slight diarrhœa. The patient had eaten freely of peanuts the night before. The temperature on admission was 100° F., but after the operation, which immediately followed, it never exceeded 99°.

An appendectomy was performed by Prof. I. R. Trimble at 5 o'clock p. m., and the patient made a complete and uneventful recovery.

Pathological Examination of Specimen.

The appendix on inspection was about three times the normal size, and about midway between the tip and the intestinal attachment the wall was thin and gangrenous, and about to rupture from distension. It was bent like the letter C.

The mucous membrane was covered in places with a dirty gray fibrinous membrane, and at its base there was an irregular ulcer. The lumen contained three soft, putty-like light-yellow concretions.

Histo-pathology.—On viewing the section under a very low power the mucous membrane and the submucous coat as well as the peritoneal layer are thickened and congested. A portion of the mucous membrane is still present, but at irregular intervals along the lumen of the appendix the mucous membrane has disappeared and is replaced by the thickened infiltrated submucous coat. The mucous membrane under a high power shows distinct exfoliation of the superficial epithelium. The intertubular tissue is thickened and contains numerous dilated capillaries and small arteries, many of the vessels show a collection of polymorphonuclear leucocytes in the plasma or outer zone of lumen and some leucocytes can be seen wandering through the walls of the vessels. The thickened intertubular tissue contains about an equal number of lymphocytes, proliferated endothelial cells, and polymorphonuclear leucocytes, and a few of the latter can be seen within the lumen of some of the mucous glands. The submucous coat is also richly infiltrated by groups of lymphocytes, proliferated endothelial cells, polymorphonuclear leucocytes, and a few plasma cells, and the solitary follicles seem increased in size, and the cellular infiltration of this coat proceeds from these thickened lymphatic structures. The muscular coat shows fatty degeneration and is also richly infiltrated with polymorphonuclear leucocytes and contains here and there small groups of pus cells mixed with lymphocytes. The arteries of the submucous and muscular coats all show a peripheral zone of leucocytes. The peritoneal coat presents a remarkable picture. It is greatly thickened and contains numerous distended capillaries and small arteries. The adventitia and perivascular lymph spaces of these vessels contain numerous lymphocytes and polymorphonuclear leucocytes. The wavy thickened tissue of the peritoneum is diffusely infiltrated by polymorphonuclear leucocytes, and it also shows numerous scattered areas of hemorrhage and in a few places some fibrin. The condition is not a peritoneal exudation but simply an infiltration of the thickened meshes of the peritoneal coat. In areas where the mucous membrane has become lost the thickened submucous coat is either covered by a thin layer of coagulative necrosis or consists simply of a raw suppurating mass of fibrin and pus cells. The submucous coat beneath these areas is tremendously thickened and seems to consist almost entirely of areas of hemorrhage and polymorphonuclear leucocytes and a few eosinophiles. The muscles beneath the thickened submucous coat are more richly infiltrated with pus cells. The peritoneum is thickened and contains more pus and fibrin.

In other sections taken from the appendix, there are no signs of distinct ulceration, and the glandular structure of the mucous membrane is fairly well preserved, but the proliferation of surface epithelium is very marked and the surface is covered in places by bile-stained masses of proliferated epithelium, lymphocytes, and a few pus cells. There are no distinct complete losses of mucous membrane as those noted above, and the condition of the various coats is similar to that described above. There is a curious condition of the lymphatics of the muscular coat present; these are greatly dilated and closely packed with small masses of lymphocytes.

The section made from the mesoappendix shows that the purulent infiltration has not extended to this tissue.

Bacterial Staining.—On staining the sections with eosin and methylene-blue the superficial areas of necrosis are seen to contain numerous bacilli of two distinct kinds. One variety is long and thin and probably represents the *B. pyocyaneus.* The other is small and ovoid and is probably the *B. typhosus.* A few bacilli can be seen in the purulent infiltration of the submucous coat, and the dilated lymph spaces of the submucous and muscular coats contain masses of the smaller bacilli, which are probably typhoid bacilli; the thickened peritoneum does not contain any bacilli, and it can thus be seen how these organisms, although gradually advancing toward the serous coat, have not yet penetrated this structure.

The lesions of the appendix, as clearly shown by the photomicrographs, represent a mixture of two distinct processes, if we follow out the classification found in Kelly and Hurdon's book.

The portion of the submucosa which forms the base of the ulcer, and even the muscular and peritoneal coats, corresponds to the condition called acute diffuse appendicitis. This variety

shows cloudy swelling of the surface epithelium, ulceration, and general infiltration of the coats by polymorphonuclear leucocytes. This process was probably caused by the *B. pyocyaneus.*

In other portions of the appendix, where there is no surface ulceration, a marked proliferation of the endothelium of the lymphatic spaces appears, and the polymorphonuclear leucocytes are not so numerous. These changes are more characteristic of typhoid fever, and are probably the reaction to the presence of the typhoid bacillus.

Description of Photomicrographs.

The photomicrographs show the lesions of acute diffuse appendicitis, together with the proliferative changes characteristic of typhoid infection of the intestine.

Fig. 1 shows a desquamation of the surface epithelium, and a proliferation of the cellular elements of the intertubular tissue and the submucous coat of the intestine at "a" and "b." At "b" under a high power the cellular exudate consists mainly of lymphocytes and proliferated endothelial cells.

Fig. 2 shows the thickened intertubular tissue under a high power, and a cross section of a mucous gland can be seen in the center of the picture. The tissue surrounding this gland consists mainly of small lymphocytes and endothelial cells. A few polymorphonuclear leucocytes are also present, and these can be occasionally seen wandering between the epithelial cells into the lumen of the gland.

Fig. 3 shows the infiltrated submucous coat at the edge of one of the ulcers, and consists almost entirely of proliferated endothelial cells and small lymphocytes, with small, round, darkly-staining nuclei. The first three photomicrographs are all taken from the edge of the ulcer near the surface and represent the proliferative changes described by Mallory in typhoid infection of the intestine.

Fig. 4 indicates in a striking manner the condition known as acute diffuse appendicitis. The lower half of the picture shows many groups of polymorphonuclear leucocytes separating bundles of involuntary muscle fibers, as indicated by the spindle-shaped nuclei. The upper half of the picture shows the greatly thickened peritoneal layer of the appendix. Several congested vessels are seen in the center of the picture, and the rest of the peritoneal layer consists almost entirely of polymorphonuclear leucocytes. Fig. 4 represents a reaction to *B. pyocyaneus.*

Bacteriological Examination.

Cultures were taken from the base and apex of the appendix, and two distinct varieties of colonies developed. One set of colonies was of a greenish color, and the surrounding agar was also green. The other set was moist and bluish to transmitted light. The moist colonies corresponded in their color and cultural characteristics to *B. pyocyaneus.* One cubic centimeter produced fatal purulent peritonitis in guinea-pigs. The second organ was found to be *B. typhosus,* giving all of the cultural characteristics of this organism.

The blood of the patient, in a dilution of one to fifty, was tested with the *B. pyocyaneus* and *B. typhosus* isolated from the appendix. *B. pyocyaneus* gave no reaction, but *B. typhosus* gave a positive reaction when mixed with the patient's blood.

This test was made one week after operation, and it seemed more likely that the reaction was produced by a recent infection with *B. typhosus* than by an attack of typhoid fever thirteen years before.

It is possible, however, that the typhoid bacillus may have remained in the gall-bladder ever since the attack of typhoid fever 13 years previous to the present attack.

Hunner[1] has reported a case of a greatly distended gall-bladder in a woman, aged 54, containing a thin, yellow pus. This was discovered after the removal of an ovarian cyst, and cultures gave a pure growth of the typhoid bacillus. Inquiry revealed the history of an attack of typhoid fever 18 years before the discovery of the typhoid bacillus in the gall-bladder.

This writer has also collected several other cases from literature in which the typhoid bacillus, usually accompanied by gall-stones, has been found in the gall-bladder at periods of six weeks (two cases), three and one-half months, and five months after attacks of typhoid fever. The most interesting cases are Miller's case occurring seven years after probable typhoid, and v. Dungern's case in which typhoid bacilli were found in the gall-bladder 14 years after an attack of typhoid fever.

Many of these cases showed cholecystitis, proving that complete immunity to the typhoid bacillus had disappeared. The typhoid bacillus, confined for years in the gall-bladder, may have found a more congenial atrium for infection in the normal lymphoid follicles of the appendix than that afforded by the scar tissue in the Peyer's patches of the small intestine.

The patient's blood also gave a positive reaction with a known typhoid bacillus, and the bacillus isolated from the appendix reacted with known typhoid blood from several different cases of typhoid fever.

The case is of interest for several reasons. The isolation of the typhoid bacillus and *B. pyocyaneus,* and the absence of *B. coli communis* in a case of acute appendicitis is the first point of interest; the second interesting feature is the production of the Widal reaction in a primary mixed typhoid infection apparently limited to the appendix.

We believe the infection was limited to the appendix, because 48 hours after its removal the temperature dropped to normal. The third point of interest is the presence of fecal concretions which resembled partly digested peanuts following the history that the patient had eaten many peanuts twenty hours before the attack.

The lesions found in the appendix were also of a mixed character. The diffuse purulent infiltration of the various coats was probably produced by *B. pyocyaneus,* while the proliferative changes in the intertubular tissue, and the submucous coat were the result of the typhoid bacillus.

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[1] Johns Hopkins Hospital Bulletin, August-September, 1899, p. 163.

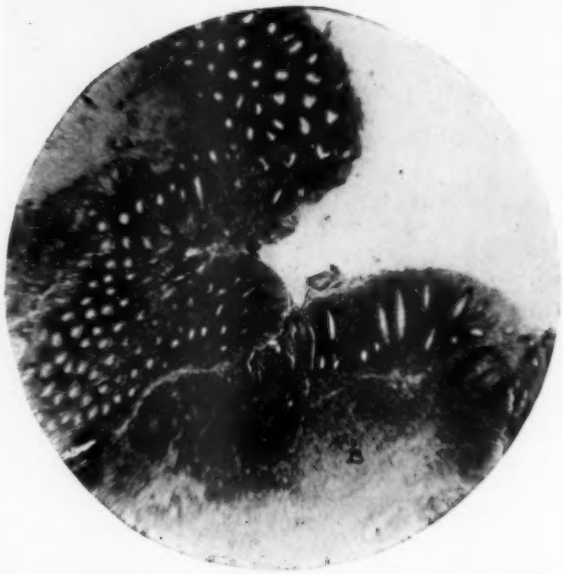

FIG. 1.—Mucous membrane on edge of ulcer showing loss of surface epithelium, infiltration of intertubular tissue at "a," and of submucous coat at "b."

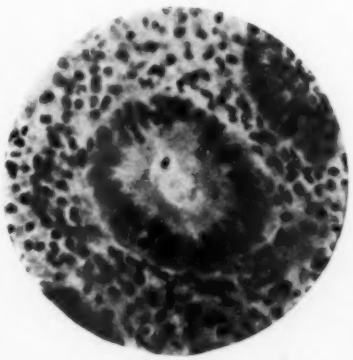

FIG. 2.—This shows a mucous gland of the appendix from Fig. 1 under the high power. The lumen of the gland contains a few polymorphonuclear leucocytes, and the intertubular tissue contains polymorphonuclear leucocytes, small lymphocytes, and endothelial cells.

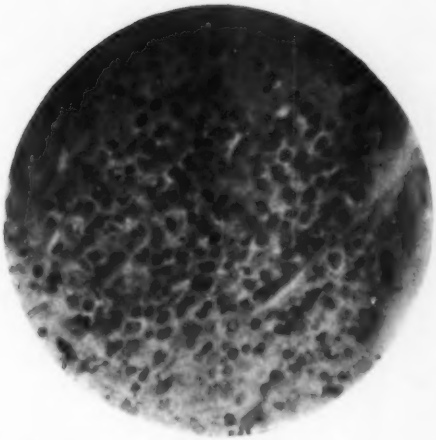

FIG. 3.—Submucous coat on edge of ulcer showing many proliferated endothelial cells and lymphocytes.

FIG. 4.—Diffuse purulent appendicitis showing groups of polymorphonuclear leucocytes between the bundles of involuntary muscular fibers. The connective tissue of the peritoneum is also greatly distended by this purulent exudation which ends just before reaching the free surface of the peritoneal layer of the appendix.

THE PATHOLOGICAL ANATOMY OF EXOPHTHALMIC GOITRE.[1]

PRELIMINARY REPORT.

By W. G. MacCallum, M. D.,

Associate Professor of Pathology, Johns Hopkins University, Baltimore.

Notwithstanding the general agreement as to the histological characters of goitre in Graves' disease as described in literature, the most recent authors, A. Kocher and Reinbach, declare that there is no constant typical anatomical alteration. Nevertheless, in our series of 28 cases there has been found a lesion, similar to that described by Farner, with great constancy, although not always in the same degree. It is noteworthy that these cases were not derived from goitre regions. The more extreme alterations correspond exactly with those described by these various authors in the majority of their cases, but there are some in which these changes are found only in foci scattered through the gland.

Characteristic changes are to be observed in: (1) the form and size of the alveoli; (2) the character of the epithelial cells; (3) the character of the colloid; (4) the vascular supply; (5) the connective-tissue framework; (6) the lymphoid structures of the thyroid.

The alveoli vary greatly in size and form; many of them showing remarkable folding of the epithelium so that the cavities have the appearance of sending off long diverticula. Frequently these diverticula become constricted off from the remainder and new alveoli are thus formed. Sometimes these small new alveoli are very numerous and surround the older ones in the form of a colony which may be outlined by the denser stroma which surrounds the whole. This resembles almost exactly the alteration which was produced in the experiments of Dr. Halsted after the partial extirpation of the thyroid gland, that is, the condition of compensatory hypertrophy.

Changes in the epithelium consist in general in an alteration from the flat or cubical type to the high cylindrical form. The cells show frequent mitotic figures, and there are abundant granules of fat in their protoplasm. The cylindrical form is characteristic, but the height of the cells varies greatly. Alteration, such as the formation of the colloid cells of Langendorff and Hürthle and the *schmelzepithel* of Hürthle, are frequently found, but it seems probable that these are degenerative changes. Langendorff's canals are not to be seen. Occasionally there occur in the walls of the alveoli very large cells with very large vesicular nuclei which are intercalated in the lining of cylindrical cells. There appear also intercalated cells, or whole groups of cells, or even groups of alveoli lined with large, irregular cells provided with deeply staining nuclei and with granular eosinophile protoplasm. These have been described by Farner and Haemig. Their significance is not clear.

The alterations in the colloid consist chiefly in its marked diminution in amount and in the ragged appearance of that which is present. The colloid in some places is homogeneous in appearance and fills at least some of the alveoli, but in many cases it is reduced to minimum and appears only as a shreddy, vacuolated, granular mass. It is usually retracted from the epithelium, being connected with it by threads which run to the lines between the epithelial cells, and there is left a thin covering of colloid over the surface of the epithelium. It is apparently easy to show by the direct application of fixing re-agents to frozen sections of the thyroid that this separation from the epithelium is a retraction phenomenon and not due to the appearance of a colorless secretion over each cell. The colloid frequently contains desquamated cells and leucocytes. Its relations to the interstitial tissue and the lymphatic and blood-vessels have been much discussed. It has been pointed out by Quervain that it is impossible, with our present methods, to recognize colloid with certainty in the veins, that probably the hyaline material seen in the veins or in the lymphatics is largely composed of coagulated plasma, although it may contain a greater or less amount of colloid. We have found no particular excess of this hyaline material in the lymphatics in most of our cases.

The vascular supply is extraordinarily rich, the veins being especially large and distended with blood at the operation, although in the specimen as sent to the laboratory they are inconspicuous. The friability of their walls has been remarked upon by the operator. They lie embedded, for the most part, in the very abundant connective-tissue framework of the thyroid, which is in all cases quite definitely increased in density, considerable bands of fibrous tissue being found to run through the gland and to cause a distinct lobulation of the tissue. In this interstitial connective tissue there is found also a great deal of lymphoid tissue in the form of circumscribed, scattered, lymphoid nodules, with definite *keimcentra* and well defined architecture. Corresponding with this increase in the lymphoid nodules there is an enlargement of the neighboring cervical lymph glands and of the thymus.

The thyroids in many cases show the presence of circumscribed prominent nodules, sometimes in considerable number, which are composed of a more homogeneous tissue, and which on section are seen to be made up of uniform, small, round alveoli, usually widely separated from one another, and embedded in a hyaline connective tissue. These are lined with plump, rather cubical, epithelium, and may or may not con-

[1] Read before the Johns Hopkins Hospital Medical Society, May 15, 1905.

tain colloid material. They are usually very sharply marked out from the remaining thyroid and may sometimes show an excessive number of the altered epithelial cells described above, that is, those with giant nuclei and with eosinophile protoplasm. These circumscribed nodules are found in other conditions of the thyroid and are not characteristic of exophthalmic goitre. Cysts of various sizes usually containing a clear greenish, somewhat glutinous, fluid, may also occur.

No bacteria or characteristic cell inclusions could be demonstrated by microscopical, cultural, or inoculation methods.

The parathyroid glands were examined in nine cases and were found to be practically normal in all. They show in some instances a moderate atrophy of cells and induration or increase in the interstitial connective tissue, but the alterations do not seem to be constant nor sufficiently extensive to support the idea that the parathyroids have anything to do with the development of the disease known as exophthalmic goitre.

On the whole, the anatomical picture resembles most closely that produced by Dr. Halsted as a compensatory hypertrophy, and it seems probable that this may be explained by some previous injury to the gland, possibly from some foregoing infectious disease, such as influenza, etc., although a definite history of this kind cannot always be obtained. Similar changes may frequently be produced experimentally in dogs by the injection of some injurious material into the thyroid vessels, or even by the maintenance throughout a considerable time of a suppurative peritonitis in which, apparently by the diffusion of some poisonous substance, there occurs a destruction of many of the epithelial cells of the thyroid, which later are replaced by the compensatory hypertrophy of the remaining cells. The nature of the primary injury which may produce such a change in exophthalmic goitre is, however, by no means always clear.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

May 15, 1905.

Clinical Features of Thyroid Hypertrophy. DR. HALSTED.

Dr. Halsted said that one or more of the symptoms usually known as "exophthalmic goitre" might occur with various pathological conditions in the thyroid. Cysts, adenomata, carcinomata, and even "normal" thyroids had given such symptoms. No sharp line could, indeed, be drawn between perfectly normal people and those with extreme hypertrophy. The well-known symtom-complex is sometimes present without hypertrophy of the gland. The condition is more frequent in females (4.6 to 1) though late in life the proportion is smaller. The prognosis is bad and it is doubtful if complete recovery has ever occurred. Twenty-five per cent of all the patients die within a short time and the rest remain in a state of labile equilibrium. Acute cases occur—one, reported in Nothnagel, appeared in two days and disappeared in eight. The mild form of the disease has been particularly studied by the French; and all observers have noticed that there is no sharp line of demarcation between normal patients and those with mild goitre. In the cystic cases there has usually been no hypertrophy of the non-cystic portions of the thyroid. In the Johns Hopkins Hospital there have been 46 cases of goitre with symptoms operated upon. The majority of these were mild but a few were severe. There was one death in the series. And in this case nearly three-fourths of the gland was removed. At present non-operative treatment is being tried, and the X-ray is being used instead. The influence of this agent has been marked in certain of the reported cases but it is not prompt.

The Pathological Anatomy of Exophthalmic Goitre. DR. MACCALLUM.

(See this BULLETIN, p. 287.)

June 5, 1905.

Bacteriological Observations in Some Cases of Bronchiectasis. DR. BOGGS.

The application of Kitasato's method to the culture of organisms other than the tubercle bacillus was described, and also the special media necessary for cultivating *B. influenzæ*.

The bacteriological findings in five cases of bronchiectasis were then presented. Of two fatal cases, one rather acute in its course, with fever, night-sweats, and hemoptysis, and one of several years' standing, the first yielded an absolutely pure culture of *B. influenzæ* from the sputum and from the lungs at autopsy. Sections showed the organisms deep in the bronchial walls. The second showed an overwhelming preponderance of influenza bacilli, with a few colonies of pneumococcus. No cultures were obtained at autopsy. Sections showed the influenza bacilli deep in the bronchial walls and mostly intracellular.

The other cases were of a chronic nature, all with definitely demonstrable cavity formation, characteristic profuse sputum, and a history of exacerbations with fever and night-sweats. Of these, one has had profuse and repeated pulmonary hemorrhages during the past twelve years. This case gave pure cultures of influenza bacilli. One, clinically indistinguishable from the others, gave a great preponderance of pneumococcus on culture, with a few influenza bacilli, the same results being obtained from this case at an operation for drainage of the cavities. From this case also was obtained a micrococcus growing only on hemoglobin-containing media and producing on such media the characteristic sickening fetor of bronchiectatic sputa. The organism did not stain by Gram's method and grew but poorly after the first two generations, being lost on the sixth transfer. The remaining case yielded *B. influenzæ* in pure culture.

The principal points of interest deduced were: The close resemblance of these cases to chronic pulmonary tuberculosis, though in no case could tubercle bacilli or tubercles be demonstrated in the sputum or at autopsy. Their importance as possible sources of influenzal infections during inter-epidemic periods. The desirability of further bacteriological study of our chronic pulmonary diseases, and the impropriety of making an absolute diagnosis of tuberculosis when no tubercle bacilli have ever been found.

Acute Pericarditis in Pneumonia. DR. CHATARD.

(To appear in a future number of the Bulletin.)

A Study of the Physiological and Toxicological Actions of the Toxic Agent of Pneumonia. Therapeutic Observations and Indications. DR. BREM.

(To appear in a future number of the Bulletin.)

NOTES ON NEW BOOKS.

The Naked-Eye Anatomy of the Human Teeth. By THOMAS E. CONSTANT, L. R. C. P. London, and M. R. C. S. Eng. (*Bristol: John Wright & Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1905.*)

The title above is somewhat misleading. The book not only treats of the human teeth, but also of the mouth, the bony framework of the jaws, the muscular covering, the tongue, soft palate and tonsils, the salivary glands, the blood vessels and nerves, and the movements of the mandible. The descriptions are clear and the discussions of the questions which arise are thorough and most interesting. A good example is the chapter describing the movements of the lower jaw. The author shows that the temporomandibular articulation is not a simple hinge-joint and that the structures which form it are not kept in close apposition by the ligaments of the joint, which have little or no restraining power, except in preventing excessive movement. Apposition is maintained by the tonic action of the muscles that elevate the mandible and exercise a suspensory action upon it. The "dropping of the jaw" at the moment of death indicates the destruction of the tonicity of these muscles. He argues further that a hinge movement in the condyle during depression of the mandible is impossible and that the movement of the condyle is in reality a sliding one.

Such painstaking analytical studies of special anatomical regions are most valuable and must lead to important practical results. The book is to be recommended not alone to students of dentistry, but to all students of anatomy. It is well illustrated and excellently printed. It also has a good index.

Wharton and Stillè's Medical Jurisprudence. Vol. II. Poisons. By ROBERT AMORY, A. M., M. D., and ROBERT L. EMERSON, A. B., M. D. Fifth Edition. (*Rochester, N. Y.: The Lawyers' Co-operative Publishing Company, 1905.*)

It is manifestly impossible to review this work in detail, owing to the great variety of its contents. The present edition has been thoroughly recast and practically rewritten. Much of the material in former editions has been cut out and new matter more in harmony with present chemical and toxicological views has supplied its place.

We notice a full account of sulphonal poisoning, also of the evil effects of acetanilid and other coal tar preparations. Wood alcohol, too, is considered and the injury which ensues to the life, or at least to the vision of those who have been poisoned by it, is mentioned. Ptomain and toxalbumen poisons are also considered at considerable length. The possibility of death by tetany being mistaken for strychnia poisoning is not mentioned, although tetanus is considered. In some severe forms of general tetany the cramp-like character of the convulsive seizures might easily be mistaken for strychnia poisoning. It is gratifying to notice that the authors have evidently familiarized themselves thoroughly with the most recent literature regarding the newer poisons and have thus given us a book which will prove a safe guide to both physicians and lawyers.

The arrangement of the book may be somewhat criticised. There seems no good reason why the material contained in the appendix should not have been included under its proper heading in the main volume, or at least in footnotes explanatory of the text. The volume is a storehouse of valuable knowledge.

The American Year Book of Medicine and Surgery. Being a Yearly Digest of Scientific Progress and Authoritative Opinion in All Branches of Medicine and Surgery, drawn from Journals, Monographs, and Text-books of the Leading American and Foreign Authors and Investigators. Under the general editorial charge of GEORGE M. GOULD, M. D. Surgery. (*Philadelphia and London: W. B. Saunders & Company, 1905.*)

The value of this excellent Year-book has been fully tested by all who have consulted the previous issues of the series. The volume contains the newest facts in surgery and the latest developments and improvements in surgical practice. In the volume under consideration, for example, we find the latest observations upon the various methods of sterilization of the hands, a discussion of the merits of rubber gloves as compared with the use of Murphy's adhesive rubber dam, a resumé of Kraske's objections to the indiscriminate employment of the Trendelenburg posture in abdominal operations, a full discussion of the treatment of carcinomata and sarcomata by surgical operations or Röntgen-rays, observations on both local and general anæsthesia and the newer agents for securing them, a discussion of surgical intervention in diseases of the stomach in apendicitis, cholecystitis, etc. The extent and variety of the contents of this book in fact are somewhat bewildering and suggest the need of greater limitation in the number of topics and more condensation in their treatment if the present single volume is to remain one which can be easily consulted. The editorial work has been well done and the book as a whole is most creditable.

Clinical Lectures on Mental Diseases. By T. S. CLOUSTON, M. D., Edin. F. R. C. P. E., President of the Royal College of Physicians, Edinburgh; Physician-Superintendent of the Royal Edinburgh Asylum for the Insane, etc. Sixth edition. (*Philadelphia and New York: Lea Brothers & Co., 1904.*)

This new edition of a well-known and deservedly popular text-book represents many changes in scientific views. Probably no better index could be given of the present activity in the study of mental diseases than the modifications which have been made in this as compared with previous editions. The style is conversational and frequently displays the freedom and latitude of expression of the popular lecture. It is always interesting and suggestive. Rarely if ever has a more practical treatise on the treatment of insanity made its appearance. The author's classification of insanity, like everything else in the book, is a decided assistance to the student both in treatment and prognosis. In the headings of the chapter he uses alternative words which help the meaning materially; thus, for example, successive chapters are headed: "States of Mental Depression—Melancholia (Psychalgia)," "States of Mental Exaltation—Mania (Psyclampsia)," "States of Alternation, Periodicity, Remission, and Relapse (Folie Circulaire, Psychorythm, Folie à Double Forme, Circular Insanity, Periodic Mania, Recurrent Mania, Katatonia)," "States of Fixed and Lim-

ited Delusion (Monomania, Mono-Psychosis, Paranoia)," "States of Mental Enfeeblement (Dementia, Amentia, Psycho-Paresis, Dementia Precox, Congenital Imbecility, Idiocy)," "States of Mental Stupor (Acute Dementia, Primary Dementia, Dementia Attonita, Psychoma)," "States of Defective Mental Inhibition," etc. In the discussion of special topics as the distinction between melancholy and melancholia he is extremely lucid and judicious. He says: "Mere melancholy might be defined as a sense of ill-being and a feeling of mental pain with no real perversion of the normal reasoning power, no morbid loss of self-control, no uncontrollable impulses towards suicide, the power of working not being destroyed, and the ordinary interests of life only lessened, not abolished.

"Melancholia might be defined as mental pain, emotional depression, and sense of ill-being, usually more intense than in melancholy, with loss of self-control, or insane delusions, or uncontrollable impulses towards suicide, with no proper capacity left to follow ordinary avocations, with most of the ordinary interests of life destroyed, and commonly with marked bodily symptoms." Could the distinction be made any clearer?

We are gratified to notice that although, like other Englishmen, he still "shies" at the word Paranoia, and prefers some other title for fixed and systematized delusions, he is willing to print the hated name and to describe the condition to which it has been applied.

The ætiological classification of Skae in a modified form is retained and under the various headings many interesting clinical reports are given. Whatever may be said as to the scientific accuracy of such an ætiological classification (and much may with justice be urged against it) it is undeniable that this scheme of classification, if it can be arrived at with any degree of accuracy and fidelity to the symptoms present, is of great service in prognosis and treatment. The final chapter in the book, entitled, "A Summary of the General Treatment and Management of Insanity looked at as a whole: and on the Use of Hypnotics, Sedatives, and Motor Depressants," is most useful and should be in the hands of every practitioner who may be called upon to see 'nsanity cases. In the present age of therapeutic nihilism it is gratifying to find an author who believes that certain remedies are indicated in specified conditions and is able to point out what are the best. The book as a whole will be most useful.

Essentials of Bacteriology. Being a Concise and Systematic Introduction to the Study of Micro-organisms. By M. V. Ball, M. D. Fifth edition, thoroughly revised by Karl M. Nagel, M. D. With 96 illustrations and 6 plates. (*Philadelphia, New York, London: 1904.*)

This compend gives evidence of careful work on the part of both author and editor, but it is apparent that the effect of extreme condensation has been to deprive it of any value except as an aid to students who are preparing for examinations. It could not be used as a laboratory manual, nor is it full enough to be of much service to one who did not possess a previous knowledge of bacteriology.

A Text-Book of the Practice of Medicine. By H. A. Hare, M.D., B. Sc. (*Philadelphia and New York: Lea Bros. & Co., 1905.*)

The author of this new candidate for honors in the field of text-books of medicine is well known for his works on diagnosis and treatment. Accordingly, the reader looks with interest to see how he has succeeded in this new venture. It is, of course, quite impossible to review a text-book in any great detail and one usually picks out certain points. Among these the treatment of lobar pneumonia is always interesting. As might have been expected, Dr. Hare's manner of handling this subject seems excellent. He emphasizes here as throughout his work the foolishness of using routine treatment and of giving drugs without definite indications for their use. The mistakes of giving anti-pyretic drugs, of beginning stimulation too early, and of the use of expectorants during the fever, are especially noted. In the discussion of the treatment of pleurisy with effusion, we think Dr. Hare might have laid very much more stress on the value of early tapping. The advisability of this seems to be definitely established, and to wait until there are signs of pressure or the fluid remains unabsorbed for a considerable time is hardly giving the patient the best chance.

The section on the diseases of the circulation is well written. It is interesting to note that in the discussion of the use of digitalis Dr. Hare states his opinion that digitalis through its abuse does almost as much harm as it does good. Attention is drawn to the necessity of carefully examining the state of the vessels before digitalis is given, and to the necessity of reducing arterial pressure, if that be high. This is a most important point and one which is frequently overlooked.

The section on diseases of the nervous system must be always more or less of a worry to the writer of a text-book of medicine. The question of classification is always a difficult one, and Dr. Hare seems to have done well in making this as simple as possible; to the student elaborate classification is always difficult.

We consider this a very satisfactory work. The descriptions throughout are clear and no space is wasted on unnecessary discussion. The sections on treatment are especially good. The publishers have done their work well and there are a number of excellent illustrations.

Diseases of the Heart. By Edmund Henry Colbeck, M. D., F. R. C. P. (London). Second edition. (*Chicago: W. T. Keener & Co., 1905.*)

This work, which is now in its second edition, deals especially with the clinical side of cardiac disease. The work is of medium size and this compelled the exclusion of many doubtful points, which is perhaps an advantage to the student and young practitioner.

The book opens with a section on the anatomy and physiology of the heart, after which the methods of diagnosis are discussed. One point of interest may be noted, namely, the explanation given of the visible pulsation so common in the third left interspace. The opinion is given that it may be due to enlargement of the left auricle, but is probably more commonly from the infundibulum of the right ventricle. The weight of opinion now inclines to the latter being the cause in the vast majority of cases. Under the discussion of blood pressure very little is said and no mention is made of what is probably the best instrument for ordinary clinical work, namely, the Riva-Rocci instrument. Dr. Colbeck might well have given greater space to this important subject.

Then follows the bulk of the work, namely, organic affections. The discussion of these is, as a rule, satisfactory, but it seems to us that the importance of arteriosclerosis is not recognized. Arteriosclerosis is not even found mentioned in the index. The lack of consideration given to this important subject seems rather surprising. The treatment advised seems very rational. It is somewhat unexpected to find that alcohol is advised as a cardiac stimulant and in comparatively large amounts. The administration of spirits up to ten or twelve ounces in twenty-four hours would seem likely to do harm, although smaller amounts might be useful. It is equally surprising to find so much doubt expressed of the value of digitalis in aortic insufficiency.

We quite fail to understand why Stokes-Adams disease should be placed under the heading of functional disorders. Altogether, we question the advisability of using such a book as this in preference to the excellent, more elaborate treatises which we have.

A Text-Book of Medical Chemistry and Toxicology. By JAMES W. HOLLAND, A. M., M. D., Professor of Medical Chemistry and Toxicology, and Dean, Jefferson Medical College, Philadelphia. (*Philadelphia and London: W. B. Saunders & Company, 1905.*)

This text-book is evidently intended for medical students whose training in physics and chemistry has been entirely insufficient to begin the study of medicine. The greater part of the book is taken up with elementary physics and organic and inorganic chemistry. Under the various substances toxicological considerations are included. At the end of the part on organic chemistry the alkaloids (p. 13), the ptomaines and toxines (p. 5), the proteids (p. 8), and the enzymes (p. 4) are included. The last division of the book is called "Physiologic and Clinical Chemistry," and under this head are discussed digestion, blood, milk, and urine. It is clear from the above that the author has attempted to touch upon too many subjects in this small text-book, with the unavoidable result that no part is very satisfactory. The fact that only twelve pages are devoted to the proteids and enzymes (and these might have been omitted without loss) would lead one to question the propriety of calling this a text-book of "Medical Chemistry." The day of the shot-gun text-book along these lines belongs to the past. A. S. L.

A Nurse's Guide for the Operating Room. Second edition, enlarged and revised. By NICHOLAS SENN, M. D., Ph. D., LL. D., C. M., Professor of Surgery, etc. Published under the direction of the Sisters of Charity, St. Joseph's Hospital, Chicago. (*Chicago: W. T. Keener & Co., 1905.*)

The previous edition of this Guide was reviewed in Vol. XIV of the BULLETIN. In the present edition additions have been made both to the text and the illustrations. We are gratified to find the author recommending the use of rubber gloves, an omission in the first edition. The directions given for the preparation of medicated gauzes, the sterilization of catgut, the preparation of drains, and the manufacture of the different antiseptic solutions are excellent. The most valuable portion of the book to many nurses will be the careful lists of instruments given as a guide to those who may be called upon to prepare for any desired operation, the lists of ligatures and sutures required, and the materials needed for the after-dressing. The illustrations of apparatus and instruments are numerous and generally well executed. "Important test questions" at the close of the book might have been omitted without any disadvantage to the work.

The Open-Air Treatment of Pulmonary Tuberculosis. By F. W. BURTON-FANNING, M. D., Cantab., Physician to the Norfolk and Norwich Hospital. (*London, Paris, New York, and Melbourne: Cassell & Company, Limited; Chicago: W. T. Keener & Co., 1905.*)

This little book of 172 pages, "intended to serve as a practical guide to the modern method of managing pulmonary tuberculosis," accomplishes the author's aim admirably, being a simple, concise, and straightforward account of our present attitude in the treatment of this disease; "based upon experience," the author writes, and indeed there is not a single paragraph which does not bear the mark of having come from one who has traversed the ground personally and thoroughly. The book is very readable, all but an occasional reference to the literature and to statistics having wisely been omitted. Following the introduction is a very short chapter on the etiology of pulmonary tuberculosis, a chapter which does not add materially to the value of the book, and in which the chief views on the source and method of infection, at present so uncertain and so warmly disputed, are treated briefly and with justice. Everyone appreciates that the most important thing in successful treatment is an early diagnosis. This point is well emphasized and the essential factors are considered. Many will criticise that the use of tuberculin as an aid in early diagnosis is only casually referred to in a paragraph of ten lines. The author states that he has no personal knowledge of its value for this purpose and that the profession in England as a body has shown some hesitation in adopting it on the ground that it is not altogether devoid of risk. Certainly in America it is used more commonly and esteemed highly, and the prevailing opinion is that with due care the risks are slight. What is said of the prognosis in the various types and stages of the disease and the necessity of selecting the proper cases for sanatorium treatment is scarcely less important. He says very judiciously that we must recognize how very insufficient even our best means are to fight the disease; we must be candid with the patient and must not promise too much, or "at the end of some months spent in treatment, the patient, whose malady perhaps never admitted of complete recovery, is apt to complain that he only embarked on the course under the impression that he would certainly be cured by so many months in a sanitarium. The false statement recoils on the head of the practitioner, and the treatment is discredited in the eyes of the laity." What is particularly gratifying is to note only here and there a reference to drugs, and even then with but little praise, and to read that "the well-known mixture of soda, tinct. nux vomica, tinct. gentian, and aqua chloroformi is prescribed, perhaps, more frequently in pulmonary tuberculosis than any other medicine." Everyone who has to treat cases of pulmonary tuberculosis and has not had the advantage of studying personally modern sanitarium methods, should read the book. He will certainly learn to avoid in the early stages the false security of creosote and cod liver oil and the laxity of telling patients to live in the open air and to eat plenty of food, with the feeling that by such advice the physician discharges his duty. "Precision," as the author says, "is the secret of success."

Outlines of Physiological Chemistry. By S. P. BEEBE, Ph. D., and B. H. BUXTON, M. D. (*New York: The Macmillan Company; London: Macmillan and Company, Ltd., 1904.*)

This book represents an effort on the part of its authors to deal with chemical questions which bear directly upon physiological problems. It is not intended as a laboratory guide. It deals with theories of the newer chemistry in a very elementary fashion and will be mainly useful to those persons who have been familiar with the older chemical views and desire to acquire a knowledge of the newer. To such persons it may be commended as giving an introduction to the subject.

Medical Philology. Gathered by L. M. GRIFFITHS, M. R. C. S. Eng. Part 1: A-El. (*Bristol: J. W. Arrowsmith, Quay St., 1905.*)

In this book of 100 pages Dr. Griffiths has afforded to the reader delightful glimpses of the original meaning of many words in common use and has corrected many misconceptions which have followed a false philology. Who would have thought, for example, that hangnail originally had nothing to do with the nails, but was simply "a corne or agnele in the feet or toes"? or that the use of the word bunion was formerly not confined to a disease of the foot but signified any kind of a bump or round swelling from violence, even upon the head? Or that jaw-bone was originally chawe bone? Or that chin-cough (whooping-cough) was originally kirk-cough, from kirk (to gasp)? There are many other curious examples of word changes which cannot well be referred to for lack of space. Every physician who has leisure for studies of this character should procure and read it. It is to be hoped that the accomplished author may find time and opportunity to continue similar notes through the remainder of the alphabet.

Acute Contagious Diseases. By WILLIAM M. WELCH, M. D., of the Municipal Hospital, Philadelphia, and JAS. F. SCHAMBERG, A. B., M. D., of the Philadelphia Polyclinic. Illustrated with 119 engravings and 61 full-page plates. (*Philadelphia and New York: Lea Brothers & Co., 1905.*)

This book deals with Small Pox, Chicken Pox, Scarlet Fever, Measles, Rubella (German Measles), Typhus Fever, Diphtheria, and their allied subjects, Vaccination, Variolous Diseases of Lower Animals, the Serum Treatment of Diphtheria, and Disinfection. The purpose of the authors has been to treat of those diseases which by their extreme degree of contagiousness require to be treated in a municipal hospital. The most complete and probably the most useful portion of the book relates to Vaccination and Small Pox. Here Dr. Welch's experience for thirty or more years is fully and instructively given. The history of vaccination which precedes the consideration of small pox is also well told. We do not remember at any time to have seen the fact so well brought out that the immunity which vaccination brings is due to the gradual attenuation of the original small pox virus by passing it through a series of inoculations in an animal which is not very susceptible to the disease.

As to the treatment of small pox by local applications to prevent permanent scarring, the authors are somewhat pessimistic and agree with Gregory when he said: "There is no peculiar method which can be devised for the prevention of pits and scars. The masks and ointments formerly in use for that purpose and so highly vaunted are in reality more hurtful than beneficial." The remedy which has proven the most useful has been tincture of iodine. The iodine treatment causes the postules to shrink and destroys the offensive odor." The use of the continuous warm bath is recommended in very severe cases of the disease. The use of red-light after the manner of Finsen in the experience of the authors has proven absolutely negative.

The section of the volume which seems next in importance is that which treats of diphtheria. The general treatment of the disease is not neglected, but, as might have been predicted, in the judgment of the authors the early use of diphtheria anti-toxin offers the best hope of curing the disease.

The other sections, while presenting nothing especially new, have been written with care and will prove of great value to physicians who consult them for instructions as to the best form of treatment to adopt in emergencies which may arise in the course of these contagious diseases.

The volume is exceptionally well illustrated and attractively printed. The text, it is stated, is based upon the study of 9000 cases of small pox, 9000 cases of scarlet fever, and 10,000 cases of diphtheria. Rarely have authors had access to such a mass of clinical material!

Progressive Medicine. A quarterly digest of advances, discoveries, and improvements in the medical and surgical sciences. Edited by HOBART A. HARE, M. D., Professor of Therapeutics and Materia Medica in the Jefferson Medical College, Philadelphia, etc. Assisted by H. R. M. LANDIS, M. D., Demonstrator of Clinical Medicine in the Jefferson Medical College, etc. Volume I, March, 1905. (*Philadelphia and New York: Lea Brothers & Co.*)

Among publications of its kind Progressive Medicine occupies a deservedly high place. It consists of careful abstracts and summaries of the literature for the period considered, with conservative criticism of advances made and proposed.

The present volume contains reviews in "Surgery of the Head, Neck, and Thorax," by Charles H. Frazier; "Infectious Diseases, including Acute Rheumatism, Croupous Pneumonia, and Influenza," by Robert B. Preble; "Diseases of Children," by Floyd M. Crandal; "Laryngology and Rhinology," by Charles P. Grayson; "Otology," by Robert L. Randolph.

In each of these, the subjects for discussion have been well selected and the literature, both foreign and of this country, has been considered with sufficient detail to make the volume of practical value to the reader, as well as a good index to the best literature on the subjects.

Introduction à l'Etude Clinique et à la Pratique des Accouchments. Par LE PROF. FARABEUF et LE DOC. VARNIER. (*Paris: Georges Steinheil, Editeur, 1904.*)

A book so well known as this needs no word of commendation. For fifteen years it has been the most satisfactory guide in arranging the preliminary practice on the manikin, which has become an important factor now in every adequate course on obstetrics, before the student begins his clinical training. This new edition is essentially a reprint and presents few changes from the form in which the book first appeared, and none of these changes have any vital bearing on the previous principles laid down. The editor appreciates this and explains that a second edition has been brought out because the first has been exhausted and copies are now obtained with great difficulty and at excessive cost.

The first chapter deals with the anatomy of the pelvic canal and the second with the various positions occupied by the fœtus before and during labor. Following is a description of methods for diagnosis of these positions both by abdominal palpation and vaginal touch. Finally, a thorough and clear consideration is given of the mechanism by which the fœtus passes through the birth canal in natural and artificial delivery.

The text is strikingly perspicuous, and one finds here, as frequently in French works, a gratifying repetition of whatever has gone before that is necessary to a clear conception of the matter at hand. Thus the reader is spared a perpetual search from one chapter to another for facts which properly belong on the page before him.

The student is further aided in gaining a grasp of the subjects by a series of illustrations which it would be difficult to surpass. They are so simple and accurate and in such abundance as to constitute easily one of the distinctive features of the book.

Almost half the volume—one hundred and ninety pages—is taken up with a most admirable account of forceps operations. The impropriety of haphazard application and the great value of adjusting the blades accurately to the sides of the child's head (cephalic method) are clearly demonstrated by word and figure.

The single regret to be expressed is that a translation has not made the work more available for English students.

A Treatise on Obstetrics. By EDWARD P. DAVIS, M. D. Second Edition. (*Philadelphia and New York: Lea Brothers & Co., 1904.*)

A previous edition of this book was reviewed in the BULLETIN. Appreciating the advance recently made in the science and art of obstetrics, the author has brought out a second edition of his text-book, extending the volume of the work and introducing numerous new illustrations.

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